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USSR Report

ELECTRONICS AND ELECTRICAL ENGINEERING

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USSR REPORT

ELECTRONICS AND ELECTRICAL ENGINEERING

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RESULTS OF INVESTIGATION OF ADAPTIVE SPEECH CODES

NEKHAYEV, A. L., PERTSEVA, V. A. and SITNYAKOVSKIY, I. V.

[Abstract] A search for ways of increasing the effectiveness of speech signals in digital form lead to the appearance of various methods of encoding, used with the object of reducing the excessiveness of specific properties of the speech signal. At present, it is customary to divide speech codes into two large classe : codes of signal parameters (or vocoders), and codes of the signal form (CS^F). In telephony, preference is given to a second class of systems, which maintains naturalness of sound. Although for some time past the class of CSF has considerably expanded because of the development of codes based on the frequency representation of a signal, the greatest interest is given to such methods of encoding as pulse code modulation (PCM), differential PCM (DPCM) and delta modulation (DM). The most promising systems based on PCM, DPCM, and DM are adaptive codes which take into account the transient nature of speech. However, the developers of digital transmission systems now find it difficult to compile a complete pattern of the applicability of specific types of codes, which results from uncoordinated data and insufficient correctness of existing criteria for their evaluation. The authors of the present paper, taking into account these circumstances, evaluate the best known versions of the codes by means of subjective-statistical measurements of their characteristics. The paper is a logical continuation of a work, the results of which are discussed in a paper by A. L. Nekhayev, V. A. Pertseva, and I. V. Sitnyakovskiy, "Evaluation of Effectiveness of Codes With Forecast," Trudy NIIR, 1981, No 3. The results obtained will help developers to draw conclusions regarding the applicability of the codes considered in various communication systems. Figures 4; tables 1; references 10: 8 Russian, 2 Western.
[127-6415]

USE OF SPACE-DIVERSE PHOTORECEIVERS FOR ANALYSIS OF INTERFERENCE PATTERN

MERKISHIN, G. V.

[Abstract] Space-diverse discrete photoreceiver arrays can be used for
analysis of an interference pattern and, on this basis, for determining the
relative locations not only of two reflectors in a known plane, as has been
demonstrated earlier, but also in the more general case of two reflectors
with all three coordinates unknown. The corresponding interference pattern
consists of oblique fringes with two different space periods along the two
orthogonal coordinates in the plane of measurement. It is analyzed, assuming
a negligibly small finite radius of radiation coherence, relative to the
gauging distance and to the source dimensions, assuming also that the inter-
ference pattern has been formed by interaction of waves from high-quality
reflector surfaces without speckle noise during diffuse scattering. Calcula-
tion of the radiation intensity distribution on the input side of the photo-
receiver array, typically a rectangular one, and of the signal distribution on
its output side indicates how the space diversity of photoreceivers should be
optimized. Figures 1; references: 1 Russian.
[113-2415]

ADAPTIVE MULTIBEAM ANTENNA ARRAY

NOVIKOV, V. I.

[Abstract] An adaptive multibeam antenna array is considered which will
enhance the advantages of a plain one, namely simultaneous reception of signals
from different directions and their sequential processing. The gist is
optimization of the control for maximum interference suppression in the radia-
tion pattern. As controllable array parameters are selected the N amplitude-
phase weight factors for the N receiver elements. The principle of synthesis
is based on the statistical method, inasmuch as accurate a priori information
about the number and the coordinates of interference sources is not always
available. The optimum control is sought with respect to the signal-to-
interference power ratio as a generalized criterion. Sampled useful signals
and transmission coefficients are found to be complex-conjugate quantities,
assuming compatible formation of beams, so that synphasal equiamplitude
addition of signals from all array elements can be achieved by unique settings
of the weight factors. Calculations are simplified by letting the useful
signal power in the l-th beam be approximately equal to the k-th weight factor,
before optimizing the weight vector for maximum signal-to-interference ratio.
A narrow-band interference describable by power P and vector V of signal
distribution over the array is considered as an example, to demonstrate the
algorithm of synthesis. The algorithm, using the Butler matrix, was executed
experimentally on a computer for a linear equidistant antenna array of 32
elements with compatible formation of beams. Figures 3; references 5:
3 Russian, 2 Western (1 in Russian translation).
[118-2415]

TELEVISION TRANSMITTING ANTENNA OF DECIMETER BAND SYSTEM BASED ON TUBES 720
AND 1020 mm IN DIAMETER

BRADACH, I., Czechoslovakian Socialist Republic

[Abstract] The IV and V television bands (470-638 and 638-790 MHz) are
singled out for further growth of the television networks. In the development
of antenna systems for the transmitting stations of these bands, systems based
on tetrahedral lattice supports with a width of a tetrahedral face of more than
one meter, a number of difficulties appear which are caused by the short
length of the transmitted wave. A polar diagram in the horizontal plane of the
antenna, the panels of which are arranged on the sides of the tetrahedral
supports of such dimensions, substantially differs from the spherical. An
acceptable polar diagram, close to spherical, is obtained with transverse
dimensions of the load-carrying structure approximately equal to 300 x 300 mm.
An antenna system called the "Noligan 720" is described and its technical
parameters are presented. The dependence is given in a table of the load-
carrying capacity of the system and the amplification of the system, with
reference to a half-wave dipole, on the length of the feeder. The ADT 7006
antenna panel is described and technical data on it are presented. The system
described uses coaxial distribution of four types (AVT 8002, 8013, 8023, and
8062) intended for distribution of high-frequency energy. Figures 6;
tables 2; references: 1 Russian.
[127-6415]

UDC 621.396.67:621.391.812

ADAPTIVE ANTENNAS FOR TROPOSPHERIC RADIO RELAY LINES

FROLOV, O. P.

[Abstract] The necessity is shown for developing adaptive antenna devices
which guarantee coupling of the signal parameters with the electrical character-
istics of the antenna. Single-channel adaptive receiving antenna systems and
an evaluation of the parameters of a single-channel adaptive antenna are con-
sidered. A detailed discussion of the basic technical decisions with respect
to the structure of adaptive single-channel antennas for tropospheric lines of
radio communication, as well as the results of experimental investigations of
them, will be discussed in a separate paper. References 5: 4 Russian,
1 Western.
[127-6415]

DESIGN OF SHORT-WAVE ABSORPTION LINES

GLAZMAN, Ya. S., GUREVICH, R. V. and GUREVICH, Ye. R.

[Abstract] Absorption lines are used as loads for diamond-shaped antennas, as well as equivalents for antennas during tuning operations and measurements of transmitters. As a function of the assignment, they are designed for dissemination of power from a kilowatt up to several hundreds of kilowatts. In so doing, in wide bands (up to tenfold) sufficiently good balancing of the absorption line must be provided. Usually, a traveling-wave factor not lower than 0.7-0.9 is specified. Absorption lines of several types are listed, and a procedure is presented for calculation of the parameters of absorption lines with an assigned nominal power P_{nom}, an effective wave band λ_{min} and λ_{max}, balancing (traveling-wave factor at input of absorption line K), wave resistance of line W, and drop of the temperature of the wires of the line with respect to the air temperature ΔT. A graphical method of calculation is described and examples of a calculation of two variations of an absorption line are given. Figures 9; references: 2 Russian.
[127-6415]

ANALYSIS OF NOISE TEMPERATURE OF OPTICAL WAVEGUIDE

SOMOV, A. M.

[Abstract] Optical waveguides employed in communications systems based on earth satellites are used instead of the waveguide transmission line of an antenna in order to increase the noise quality of the receiving systems at earth points. The special features of operation of an optical waveguide, the noise temperature of the optical waveguide elements with vertical orientation of the directional pattern, and the noise temperature of the optical waveguide are considered. The author concludes that use of an open optical waveguide not only assures operation with a wider frequency band (as compared with an ordinary waveguide transmission line), but also gives an increase in the noise temperature. The nonimportance however, of the increase of the noise temperature (several Kelvins), in comparison with a shielded optical waveguide, is offset by the simplified design of an open optical waveguide. Thus, in a number of practical instances it is possible,together with the employment of shielded optical waveguides, to use optical waveguides of the open type. It is possible to compute the noise temperature of such a system by the method presented in this paper. Figures 7; references 5: 4 Russian, 1 Western.
[127-6415]

SPECIAL FEATURES OF TRANSISTOR USE FOR POWER AMPLIFICATION IN REGIME OF COMMON
AMPLIFICATION OF PICTURE AND SOUND SIGNALS

IVANOV, V. K.

[Abstract] A method is proposed for investigating the characteristics of
transistors for common amplification of pictures and sound, which agrees well
with experimental data on the use of transistors in high-frequency wide-band
amplifiers for television broadcasting. Types of transistors are considered,
the use of which for amplification of television broadcasting signals is not
recommended. On a base of domestic power transistors it it possible to con-
struct a very simple device which assures amplification of the output of tele-
vision broadcast signals up to 20 Watts. Figures 2; references: 4 Russian.
[127-6415]

EQUIPMENT FOR MONITORING AND CONTROL OF TELEVISION TRANSMITTERS

KRASHTERKA, M., Czechoslovak Socialist Republic

[Abstract] The paper completes a description of a new generation of television
transmitters, developed by "Tesla-Gloubetin" (Czechoslovakia). [Previous
articles in Russian by I. Bednarzh (New Series of "Tesla" Meter Range Tele-
vision Transmitters), and I. Nayman (Measuring Complex TMZ-81 for Television
Transmitter), which describe the transmitters, appeared in ELEKTROSVYAZ',
1982, No 9.] A system of local and remote monitoring and control is described
which enters into the composition of the transmitter, in addition to a Type
TMZ-81 measuring complex. The equipment of the system is calculated for
monitoring and control of three transmitters of any type. Figures 3;
references: 2 Russian.
[127-6415]

MULTI-CRITERIA APPROACH TO SELECTION OF OPTIMAL CONNECTIONS IN LARGE-SCALE INTEGRATED CIRCUITS

BATALOV, B. V., LYASNIKOV, Ye. P. and SHCHEMELININ, V. M.

[Abstract] In the design of large-scale integrated circuits, the simplest analog model topology involves a "comb" lay-out with connections shown as vertical sections. The problem is to determine all optimal connection variants according to the scalar criteria of circuit region charge, number of connections and total connection length. This paper formulates the optimization problem and presents models for least channel charge, least total connection length and fewest connections and for optimization according to vector criteria of quality. The concept is introduced of the lexicographic rank of the vectors according to certain characteristics and optimization is obtained by a comparison of vector criteria. The lexicographic approach reduces to a sequence of one-criterion problems and guarantees the existence of the optimum but requires the enumeration of all equivalents in the decision process. Figures 4; tables 2; references: 6 Russian.
[95-12497]

MEASUREMENT OF INTEGRATED CIRCUIT ELEMENT DIMENSIONS TAKING INTO ACCOUNT REAL ETCHING PROFILE ACCORDING TO DIFFRACTION PATTERN

VOLKOV, V. V., GERASIMOV, L. L., KAPAYEV, V. V., LARIONOV, Yu. V. and
RAKOV, A. V.

[Abstract] Test diffraction gratings are used to determine precisely linear elements and integrated microcircuits with dimensions approaching one light wavelength and to assess the performance of small topological elements with respect to angular curvature, dimension range and etching conditions where optical means and even electron microscopes are insufficient for objects of approximately 1 micron. This paper is concerned with randomly incident

diffraction of coherent laser light in relation to grating lines. Fractional
spectra for grating elements, taking into account etching slopes are computed.
Measurements were made at specific angles of diffraction order intensities,
and relatively precise determinations of element dimensions were obtained with
a precision of approx. 0.1 micron even for objects smaller than one light
wavelength. Figures 4; tables 2; references 8: 6 Russian, 2 Western.
[95-12497]

REALIZATION OF HIGH-FREQUENCY FILTERS ACCORDING TO THEORY OF GUIDED
SPHERICAL WAVES

KNYAZ', A. I. and DRAGANOV, V. M.

[Abstract] For the design of filters operating at metric, decimetric, and
centimetric wavelengths, their equivalent circuits must and can be refined so
as to allow for an electrodynamically reliable trimmerless construction by
satisfying the conditions for spherical T-mode waves at the junctions between
filter elements. This principle is demonstrated on a beam filter and its
equivalent low-pass circuit. A short segment of a transmission line formed
by two conical beam conductors serves as a capacitive element; their surface
is described by equations in a cylindrical system of coordinates. After the
capacitance per unit length of such an element has been calculated on this
basis, the inductance per unit length of an inductive element between two such
capacitive elements is calculated as that of a loop formed by two conical beam
conductors. Evaluation of theoretical design and experimental test data
indicate that this method is suitable for high-frequency beam filters.
Figures 2; references: 8 Russian.
[118-2415]

COMMUNICATIONS

EQUIPMENT DESIGN PRINCIPLES FOR STANDARDIZED AUTOMATED PRODUCTION PROCESS
CONTROL SYSTEMS

KUDRYAVTSEV, G. G., MAMZELEV, I. A. and CHASOVNIKOV, Ye. D.

[Abstract] The nature of the communications sector requires that automated
process control systems (ASUTP) and technical operating systems for communica-
tions equipment be merged into a single integrated system providing automated
computerized operation of communications facilities. A generalized structural
hierarchy is proposed for a standardized set of hardware and software for
technical operations systems and ASUTP's. Following a general discussion of
the composition and structure of the microcomputer based lower tier of this
standardized hierarchical system, the interfacing of computer system users with
the monitored and controlled facilities is analyzed using graph theory. The
implementation of the general principles underlying the proposed standardized
ASU [automated control system] hierarchy is illustrated using the example of a
technical servicing and control system for facility in the primary communica-
tions network. The major operational unit servicing the primary network is a
TTsUMS [territorial center for the control of trunk communications and tele-
vision], which takes the form of a spatially distributed system with a three-
tier control structure. This control system is illustrated with flow charts
showing the highest control level down to the specific ways in which the line
channels, group channels, hardware, etc., interact with the higher levels
through the common system bus. Use of computers at the level of control cen-
ters and data/actuation stations will significantly reduce labor outlays and
automate the process of decision-making with respect to network restructuring,
i.e., provide for prompt network control. In the initial stage of automating
the groups of telephone channels at intermediate repeaters; automatic TV
switcher for video and audio channels into one outgoing trunk from one main
and one standby incoming trunk; a video equalizer for coax lines, etc. In
order to avoid expensive mistakes when replacing equipment, check calculations
of the qualitative indicators must be carried out for the microwave link being
rebuilt. Greater care must be devoted to the precise alignment of antennas and
assuring the conformity of actual equipment parameters to the technical speci-
fications. Allowances must be made for expanding facilities in given regions
in the future. References 7: 6 Russian; 1 Western in Russian translation.
[101-8225]

SOME ASPECTS OF PLANNING RECONSTRUCTION OF CABLE COMMUNICATIONS LINES

REMENNIK, I. P. and DURBANOV, E. I.

[Abstract] A comparison of technical economic indicators demonstrates that the best way of boosting communications trunk capacity is the reconstruction of existing cable lines. The "Giprosvyaz'" institute has developed a series of standard plans for retrofitting cable lines. The plans call for replacing the K-1920 multiplex equipment on KM-4 cable with the K-3600; the K60P on MKS 4x4 and 7x4 cable with K-1020S equipment; K-60P and ZK 1x4 and MKS 4x4 is to be replaced with the IKM-120 PCM equipment and the K-300 and MKT-4 cable with the BK-960-2. The major task during retrofitting is curtailing the downtimes of existing services. This paper analyzes the work sequences for a variety of equipment configurations, unattended repeater spacings, availability of microwave links, etc. Successful rebuilding of cable lines in the future will require that procedures be worked out even during the process of designing new transmission systems. The discussion is general and limited to general recommendations rather than detailed specifications and procedures. [101-8225]

MAJOR TRENDS IN RECONSTRUCTION OF MICROWAVE REPEATER LINKS

RYBAS, B. V.

[Abstract] The construction of new microwave links in parallel with existing facilities requires considerable capital investments, especially considering electromagnetic compatibility requirements. This is one of the factors in favor of the reconstruction of repeater links, because compatibility is more easily attained through retrofitting. The major tasks of the reconstruction of the existing links are increasing the capacity of telephone trunks and/or the number of TV trunks, improving the equipment reliability and reducing the number of service personnel required as well as enhancing the qualitative indicators of repeater performance. This paper discusses general problems related to the reconstruction work and ways of solving them: Changeover of the R-60/120 periscopic antenna system to 3.75 cm from the old 15 cm wavelength entails antenna gain losses caused by the unevenness and deformation of the reflecting surfaces and the associated adjusting hardware cannot assure the requisite angular accuracy; difficulties arise with the use of highly directional antennas with gains in excess of 43 dB, because of wind and thermal

deformations of high antenna supports; in addition to the standardized KURS repeater hardware, a series of new standardized equipment bays and auxiliary equipment are in production which allow for optimal designs of terminals and intermediate repeaters. Unfortunately, however, this equipment is rarely used in retrofitting microwave links. Some nine units of this new equipment are listed, including such items as the OR-1 terminal and back-up rack which contains two TV, one telephone and one standby modem, service intercom channels and a trunk back-up circuit; new rack equipment for splitting out and inserting control process. It is best to use the previously drawn-up graphs for bypasses and substitutions within the framework of the existing territorial hierarchical network. The multilevel distribution of computer equipment and its application in each controlled facility at the lower level will make it possible to disperse the bypass and substitution graph schedules among the individual facilities, significantly reducing the requirements placed on memory capacity and computer speed. Adaptive control of networks is envisioned as computers become more widespread in the communications sector. Figures 7; references: 7 Russian.
[101-8225]

TECHNICAL PROBLEMS OF RECONSTRUCTION OF LONG-DISTANCE CABLE COMMUNICATIONS LINES

FARBER, Yu. D.

[Abstract] Problems have arisen during the replacement of the obsolete K-1920 transmission systems with the K-3600 on long-distance cable lines. The problem of river crossings of up to 6.0 km using the K-3600 is particularly acute, because the standardized repeater span lengths are less than 3.15 km as opposed to the 6 km which the old K-1920 system could handle. This paper proposes addenda to existing retrofit instructions for KM-4 and KM-8/6 cables: rather than attempt a major redesign of the K-3600 system, it is better to take advantage of the noise immunity reserve in the K-3600 equipment. The feasibility of this approach is substantiated numerically. Another problem is that on routes where the requisite number of channels in the long term may range from 8,000 to 14,000 using KM-4 cable, two K-3600 systems are inadequate while two K-10800 are not justified. A possible solution is the construction of a new cable line, either KM-4 or KM-8/6 cable. On long-distance MKT-4 type cables, when the K-300 systems are being replaced with the BK-960, setting up 1,920 channels is not optimal. An improved remote power supply circuit is proposed which allows retrofitting the existing long-distance cables with the VLT-1920 system to produce trunks of 3,840 channels each. Tables 1; references: 1 Russian.
[101-8225]

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EXPERIENCE WITH RECONSTRUCTION OF CABLE TRUNKS

MEYERSON, S. M.

[Abstract] The TTsUMS-5 [Territorial Center No. 5 for Long-Distance Communications and Television System Management] includes 9 technical centers for all-union trunks and one repair and construction administration. Cable trunks handle 90% of all telephone traffic within this administration. TTsUMS-5 encountered a number of difficulties during the retrofitting of these trunks with new equipment. This paper discusses the reconstruction of balanced cable trunks, involving the replacement in the 1970's of the K-60 vacuum tube gear with the K-60P transistorized equipment. It was found that cables with paper/cord insulation exhibit poor isolation in the upper portion of the spectrum, which prohibited attaining the nominal crosstalk levels. Isolation networks produced points of concentrated crosstalk in some instances which required the use of special pulse testing equipment for fault location, and industry was not producing the needed line equalizers. Problems related to the reconstruction of coaxial cable trunks involving the installation of the new K-3600 and BK-960 systems, which was started in the current five-year plan, are also discussed, including the preparatory work, the splicing of bypasses into the cables and the actual reconstruction itself. Unresolved reconstruction problems include the fact that equipment is still received with damaged components and deliveries are frequently late. Warranty repair work by the manufacturing plants is often put off for a long time, forcing operational enterprises to use their own technicians. No procedure has been worked out for locating faults in a trunk remote control repeater, which considerably complicates the work of alignment and operation of the transmission system equipment. The question of measuring the noise power in a line channel when it is loaded with white noise is still unresolved. Problems of providing the high capacity K-3600 and BK-960 transmission systems with the necessary instrumentation, work positions and parts and modules for equipment repair, as well as fault detectors for breaks in the remote power supply wire must be solved. Figures 1.
[101-8225]

LIMITS TO INCREASING DENSITY OF MICROWAVE REPEATER NETWORK

KALASHNIKOV, N. I., KALININ, A. A. and KALININ, A. I.

[Abstract] This paper is a detailed theoretical analysis of a microwave repeater network consisting of a large number of individual microwave links operating in the 2 to 8 GHz band. The network is assumed to have the form of a rectangular grid, consisting of strings of repeaters forming links running north and south where these strings form parallel links spaced uniformly in the

east-west direction. The spans of the north-south repeater links are assumed all to be the same; the east-west spacing of the various links is also the same. The worst case is assumed for the frequency allocation: the transmit frequencies of the terminal stations are the same. Diagonal and lateral crosstalk between stations is disregarded, assuming adequate directional immunity of the antenna systems. Mathematical expressions are derived defining the interference, based on the permissible increase in the noise level in telephone channels for 20% of the time. The allowable physical separation along east-west spacing of the links is found as a function of span lengths (north-south spacing between individual repeaters) for frequencies of 2, 4, 6 and 8 GHz. The permissible physical spacing between microwave links (east-west spacing) falls off significantly as the span lengths within a link decrease, an effect which is more pronounced, the higher the frequency is. It is possible substantially to boost repeater network density by shortening the spans. The power parameters required for the repeater equipment also fall off as the span length is decreased. The maximum possible spans for which signal facing can still be disregarded are summarized in tabular form. The attainable density increase for a microwave repeater network is approximately two to four times, while retaining the existing of levels of additional noise in the channels caused by crosstalk. Figures 4; references 9: 6 Russian, 3 Western.
[101-8225]

ORGANIZING DATA STORAGE WHEN SETTING UP AUTOMATED TELEGRAM INDEXING SYSTEM

KANAYAN, S. N. and MATEVOSYAN, N. P.

[Abstract] It is planned that the automated telegram indexing system (ASIT) will use the facilities of the message switching computer center, thus necessitating its use of a portion of the processor time in the main computer. Economic utilization of this processor time requires an efficient organization of the data base in order to assure minimal retrieval time for the indexing data, given the existing limitations on the available main memory capacity. The logic level of the data base for the two proposed types of ASIT's (territorial and zonal) has a four-tiered structure with an upper hierarchical level containing the catalog of trunk indexes corresponding to the number of zones into which a territory is divided. Each entry in this catalog contains the address (or name) of one of the files in the next sublevel, which is also a catalog including populated centers and administrative regions. The sublevel contains the address (or name) of the file for the third level down, and so on. The process of retrieving the requisite data is discussed. A detailed mathematical description of the file structure of the data base is provided for the case where peripheral magnetic disk memories are used. A sample calculation is given for the optimal size of data base files for a hypothetical territorial

telegraph network. The proposed technique enhances the efficiency of an ASIT and reduces to the optimization of the size of the files in the ASIT data base, i.e. the minimization of the average telegram indexing data retrieval time. Figures 1; references 8: 5 Russian, 3 Western in Russian translation. [101-8225]

CONSTRUCTION AND OPERATION OF MICROWAVE REPEATER LINKS FOR INTRAZONAL SERVICE

Moscow ELEKTROSVYAZ' in Russian No 12, Dec 83 p 34

SERKOV, Yu. M.

[Abstract] The present status of construction and operation of microwave relays using the KURS-8-O, KURS-8-OU, KURS-8-OT and KURS-2M equipment as well as the prospects for the expansion of the microwave network in the 12th Five-Year Plan were discussed at a conference held in Groznyy in June of 1983. This article very briefly reviews the work of the conference. The USSR Ministry of Communications and the RSFSR Ministry of Communications assign great importance to the construction of microwave repeaters with the above equipment. The manufacture of the KURS-8-O2 series is planned; it is designed for operation with both analog and digital systems. This equipment is built as a modular container and can be installed on a microwave support tower or at its base. Considerable work on microwave relay construction is underway in the Communications Engineering Administration of the Checheno-Ingushskaya ASSR, where the conference participants observed the joint operation of the KURS-8-OT and KURS-8-O equipment, which provides simultaneous long distance telephone service and a feed for the Channel 1 all-union TV program. In line with the recommendations adopted at the conference, the communications engineering administrations must consider the fact that starting in 1984, digital trans-mission systems will primarily be used on intrazonal microwave links, based on the NC-30 channel generation equipment (made in Finland), the "Zona-120" secondary time group generation equipment and the OTsF-8 terminal digital equipment. When working out the planning and estimate documentation, the rules are established by the Supplements to the Previously Authorized Standard Project Plan for Microwave Repeater Construction, using the "Oblast'" type equipment. The local communications engineering administrations can order these materials from the State All-Union Planning Institute. [101-8225]

UTILIZATION OF COMPOSITE VOICE FREQUENCY CHANNELS FOR DATA TRANSMISSION

DIVNOGORTSEV, G. P.

[Abstract] Composite voice frequency channels using direct physical lines between a municipal telephone exchange and multichannel transmission systems are needed for data transmission in large cities and between the lessees of long distance lines. This paper demonstrates the feasibility of setting up data transmission channels using existing hardware, based on experience in the Main Information - Computer Center of the Automated Control Systems for the 1980 Olympics communications facilities. These channels employed a four-wire configuration with a single voice frequency repeater in the olympics communications center. The limited number of outputs (38) from the communications processor of the main center computer was expanded by using a line transformer with five secondaries to drive two cable pairs and three lines to the IKM-30 pulse code-modulation (PCM) equipment from a single main computer output line via a modem. Graphs are plotted showing the actual frequency response of the various channels as well as the response required by existing standards. The voice frequency channels through the IKM-30 PCM equipment meet all standards of the International Telegraph and Telephone Consultive Committee. They assure an error rate per transmitted character of no more than 10^{-6} when transmitting four-phase modulated signals at a rate up to 2,400 bit/s. The switching of the subscriber network of the municipal telephone system is not suited for data transmission via leased channels: the cold, screw-secured contacts in them must be replaced with more reliable contacts. Fears of dropouts in the four-phase signal caused by the considerable phase flutter were unfounded, because the flutter in the voice frequency composite channels of the IKM-30 equipment does not exceed 2°, where the permissible value is 15° (peak to peak). The allowable data transmission signal levels in voice frequency channels must be standardized when time-division multiplexing is used. It is expedient to set these levels at the following measurement levels: 0 dB for a two-wire input and -13 dB for a four-wire input. The UMP-20 (or 100) positive gain amplifiers inserted in the "direct wires" of the municipal telephone network do not have excessive phase distortions for data transmission which uses four-phase modulation at the 2,400 bit/s rate. Figures 5; references 5: 4 Russian; 1 Western. [101-8225]

MEANS OF ACCELERATING SCIENTIFIC-TECHNICAL PROGRESS IN LEADING SUBBRANCHES OF
ELECTRICAL COMMUNICATIONS

[Abstract] This paper considers the decree of the CPSU Central Committee and
the USSR Council of Ministers "On Measures Concerning Acceleration of
Scientific-Technical Progress in the National Economy" to be an important
step on the way to realization of the course drawn up by the 26th CPSU Congress
on the comprehensive intensification of the public production, resolutions
of the November (1982) and June (1983) Plenums of the CPSU Central Committee.
The entire decree, which stresses the increased measure of use in the national
economy of the achievements of science and technology, is summarized in the
article. However, in the present abstract only material concerned with commun-
ications is considered. Concrete measures are indicated in the decree, directed
to improvement of the use of the scientific-technical potential of the country,
intensifying the integration of science and production, coordination of work
and the concentration of forces on the most important directions of the techni-
cal re-equipment of production, improvement of the organization of work,
acceleration of the introduction of the newest technics and technology. It is
necessary to concentrate efforts of the specialists in the area of long-
distance telephone communication on augmentation of development. Industrial
assimilation and introduction to main line and zone networks of analog and
digital systems of transmission K-10800, K-5400, K-1800, IKM-480 x 2, IKM-480S,
IKM-480R, IKM-1920 x 2, IKM-120U, optical cable communication systems; auto-
matized operation-technical maintenance systems of the primary and secondary
networks; digital and analog radio relay systems for transmission of increased
capacity, including the devices of an autonomous electrical supply station, and
their life-support (and survival) systems. It is necessary to complete develop-
ment and to conduct operational tests of an automatic long-distance telephone
(ALDT) exchange with time switching, complexes of equipment of the operating
location of telephone operators for organization of manual and semiautomatic
communications and units of the call-information services of ALDT of all types;
more widely to introduce lightning-proof and noise-immunity coaxial and
balanced cables. Development of municipal and rural networks must proceed on
the way of an increase of the effectiveness of use of switching equipment and
linear-cable construction on the basis of the development and introduction of
more perfect switching systems, digital transmission systems at interexchange
and subscriber's sections (IKM-120, IKM-30-4, IKM-30S, Zone-15); complexes
of hardware components for centralized operation of municipal and rural net-
works; apparatus for computation of the cost of telephone conversations; pro-
cessing of information for accounts with subscribers, and expansion of the
nomenclature of the services being assigned.
[127-6415]

ENGINEERING METHOD OF CALCULATING CAPACITY OF SYSTEM WITH COMMON
SIGNALING CHANNEL

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 84 (manuscript received 2 Nov 82)
pp 7-10

DEDOBORSHCH, V. G., GROMOV, A. I., and URM, E. E.

[Abstract] A system with a common signaling channel (abbreviated as OKS in
Russian) is a multifunctional system, analysis of which is extremely compli-
cated. Known methods of analysis of systems with OKS assume its division into
several functional levels, which, with the object of simplification, it is
possible to consider separately or together. This paper puts forward a simpli-
fied engineering method for calculating the capacity of a system with OKS. In
so doing, it is considered as an enlargement of a two-level system, where the
first phase conditions the functions of processing communications and the
second phase, the functions of transmission of communications. The permissible
utilization of OKS, calculation of the flow of telephone communications enter-
ing an OKS, and the capacity of an OKS are discussed. The authors conclude
that the methods presented for calculation of the capacity of a system with OKS
make it possible with a minimum of computing means to evaluate the permissible
utilization and the capacity of a system with OKS over a wide range of changes
of the transmission speed of communications. Taking account of repeated calls
makes it possible more precisely to describe a system with OKS. Figures 2;
tables 1; references 6: 4 Russian, 2 Western (1 in Russian translation).
[127-6415]

UDC 621.395.38

COMPUTER SYNTHESIS OF LONG-DISTANCE NETWORK WITH COMMON SIGNALING CHANNEL

Moscow ELEKTROSVYAZ' in Russian No 1, Jan 84 (manuscript received 2 Oct 81)
pp 10-12

ZHARKOV, M. A., and CHITISHVILI, T. I.

[Abstract] The paper considers that one of the important measures for further
automatization of a long-distance telephone network is the introduction of
centralized signaling systems, and the gradual replacement by them of decentral-
ized systems. Replacement of decentralized signaling systems (single and
double frequency) by a long-distance telephone network based on a system with
a common signaling channel (abbreviated as OKS in Russian) makes it possible to
achieve a number of (listed) advantages. In accordance with a number of con-
ditions, an 8-part algorithm is developed for synthesis of an optimum network
with an OKS, which guarantees a minimum capital outlay on its construction.
The operating time of a program composed in accordance with the algorithm
described, for 10-12 long-distance stations, based on a YeS-1022 computer, is
on the order of 2 minutes. References 4: 3 Russian, 1 Western.
[127-6415]

17

ESTIMATE OF MESSAGE DELAY IN SYSTEMS WITH DATA PRIORITY PROCESSING

MILOKOSTYY, I. V., and PETROV, A. F.

[Abstract] It is possible to identify a number of telephone systems with a
common signaling channel (abbreviated as OKS in Russian) which have all the
characteristics of a system with switching of communications which guarantees
transmission of telephone communications with units of constant length.
Methods for analysis of multiphase (MP) systems of mass servicing (SMS), in
particular, with a constant time of servicing (MPCTS), can be successfully
used for analysis of such systems. In the development of data transmission
systems, a system of priorities is used for assigning message preference as a
function of the class of its importance, urgency, and others, which extremely
complicates their analysis. The present paper derives an expression for the
average time of stay (delay) of communications in the MPCTS with a comparable
priority. During analysis of a concrete technical system, these expressions
can be used for an evaluation of the time parameters of transmission and pro-
cessing (delay) of information. An analysis of MPCTS with priorities, and an
evaluation of the precision of expression for the average time of stay of
communications in MPCTS are considered. A comparative analysis of the data
obtained was conducted with various values of the loads of individual phases
of MPCTS. The principal original data and the results of calculations and
experiment are presented in two tables. Figures 2, tables 2, references 6:
3 Russian, 3 Western (1 in Russian translation).
[127-6415]

CHOICE OF DATA TRANSMISSION NETWORK OPERATION-TECHNICAL SERVICING INDEX SYSTEM

KUDRYASHOV, V. A. and RASCHESOVA, A. G.

[Abstract] The presence of large and complex programmed maintenance, which
as with the network itself, has a multilevel structure, is characteristic of
contemporary data transmission networks. It includes in itself a complex of
algorithms which implement the process: functional network for transmission of
information between adjacent and nonadjacent elements (system of minutes); on-
line control of the structure of network and flow (control system); evaluation
of network condition, as well as collection, processing and analysis of statis-
tical information on the network operation (system of investigations). All
these systems form the operation-technical servicing (OTS) of the data trans-
mission network. The present paper considers the purposes of the OTS, the

functional model of the data transmission network, indices at the level of network-user, functional-multilevel structure of the OTS, and the structure of a mathematical model of the OTS. The authors conclude that the problem of analysis and synthesis of an OTS system can be solved on the basis of their proposed functional-multilevel structure, allowing for the requirements which are determined by the user. It is necessary to satisfy the rigidity of structure of the OTS of the data transmission network, because not one of the characteristics of its subsystem can be considered as isolated from the overall structure of the system. Change of any of them necessarily influences the stability of the quality of operation of the network on the whole and the effectiveness of the OTS procedures. The final choice of the subsystems of the OTS must be made, taking account of the minimum of the required resources of information and programmed maintenance, and the cost of the output of processors and the transmitting capacity of the communication channels, based on a guarantee of the operation of an OTS system, i.e., the minimum of the adduced outlay on organization of the OTS procedure. Figures 2; references 9: 7 Russian, 2 Western in Russian translation.
[127-6415]

MULTIPLEXER TRANSMISSION OF TELEGRAPH COMMUNICATIONS

DOLBAKYAN, A. Ye.

[Abstract] This paper is concerned with telegraph centers for communication switching (TsKS-T). TsKS-T are intended for automatization of the procedures for reception, processing, switching and transmission of communications at telegraph centers; increase of the rate of work of operators at telegraph points; reduction of the transmitting time of messages and an increase of the accuracy of their transmission; a decrease of the operational costs and the complement of production personnel. The TsKS-T consists of the VK-1033 computing complex, software systems, functional servicing and control, and equipment (AS-160) for coupling communications channels with an electronic computer. The AS-160 assures coupling of 160 low-speed telegraph channels, operating at speeds of 50, 100 and 200 bauds. A technical and economic comparison is made of two methods of increasing the carrying capacity of the TsKS-T. It is shown that an increase of the center's carrying capacity by using a highly productive electronic computer is noneffective. Figures 2; tables 1.
[127-6415]

USE OF MIRROR-PRISM SETS WITH AUTOCOLLIMATORS IN INSPECTION OF PRISMS FOR
ANGLE ERROR

TAREYEV, A. M.

[Abstract] Misalignment during inspection of dihedral angles by comparison with
a reference standard using an autocollimator can be avoided by using special
mirror, prism, or mirror-prism sets with the autocollimator. Such typical set
for checking a 90° dihedral angle consists of three prisms with a light-
splitter coating which are glued together so as to split the light beam coming
from the autocollimator into two beams. Both impinge on the tested prism and
each forms an image of the autocollimator marker in the field of vision, if the
angle between the two beams is 90° and the prism angle is off 90°. The angular
distance between the two images of the autocollimator marker in the direction
corresponding to the principal section of the mirror-prism set is equal to twice
the angle error of the inspected prism. Four variations are possible for
orienting the axes of coordinates in the measuring system which consists of the
autocollimator with mirror-prism set and the tested prism on a stage. Their
performance is most expediently analyzed upon replacement of each beam channel
with a corresponding coordinate-transforming equivalent mirror set. Accord-
ingly, consideration is given to a plane mirror, a pair of mirrors at an angle
with parallel edges, a pair of mirrors at an angle with common edge ("roof"),
and a triad consisting of a "roof" pair and a separate single plane mirror.
Calculations based on geometrical optics and verified experimentally indicate
the best variant or combination for inspection of any specific type of prism.
Figures 2; tables 3; references: 7 Russian.
[113-2415]

ESTIMATING COLORATION OF PLASTICS

GRUZDEVA, N. I., DEMKINA, L. V. and SHEPUREV, E. I.

[Abstract] Coloration of five polycarbonate plastics was estimated, both
visually in daylight and by measurement according to a method suitable for
industrial quality control during their production. These materials were three
grades of Diflon OL (slightly yellow, luminescent with decolorizer, intensely
yellow general-purpose) produced in the USSR, colorless Macralon produced in
the FRG, and slightly yellow Lexan produced in the US. Their transmission
coefficients for the blue light τ_b (450 nm) and for red light τ_r (650 nm) were
measured with equipment consisting of a collimator-type light source, a con-
densing lens, an objective, and interchangeable interference-type light filters
before the specimen, a radiation receiver with an indicating instrument behind
the specimen. The deviation of the blue-to-red ratio from unity $1-\tau_b/\tau_r$ yields
a direct measure of yellowness. This has been verified by comparison with the
more rigorous but also much more tedious method of calculating the yellowness
index from the three standard chromicity coordinates in the light of a standard
(GOST 7721-V) lamp after measurement of the spectral transmission coefficient
over the visible (400-700 nm) range of wavelengths. Figures 3; tables 3;
references: 5 Russian.
[113-2415]

OPTICAL TRANSMITTIVITY OF SAPPHIRE AFTER HIGH-TEMPERATURE ANNEALING

KONEVSKIY, V. S., KRIVONOSOV, Ye. V. and LITVINOV, L. A.

[Abstract] An experimental study of sapphire was made for the purpose of deter-
mining the effect of high-temperature annealing on its optical transmittivity.
Twelve specimens were grown by the Verneuil method, 3 mm thick and 20 mm in
diameter, with crystallographic (1120) or (1100) orientation of planes. They
were grouped into three batches of four with different orientations. They were
ground with a B_4C wheel, all to a surface finish Rz = 0.05 μm on one face but
to Rz = 6.3-10 μm, Rz = 1.1-2.5 μm, and Rz = 0.1-0.2 μm respectively on the
other face. They were subsequently annealed for 1.5 h and 8 h at 1980° in
saturated vapor of Al_2O_3 and its thermal dissociation products under a residual
pressure of $7\cdot10^{-4}$ mm Hg. Surface profiles and the scattering indicatrix were
measured before and after annealing. The results reveal that annealing changes
the transparence and the integral transmittivity of sapphire significantly and

increasingly so with longer annealing time, those of specimens with the rough-
est surface finish (deepest defective surface layer) having increased most,
those of specimens with the intermediate surface finish having increased less,
and those of specimens with the finest surface finish having decreased slightly,
regardless of the crystallographic orientation. These changes are attributable
to recrystallization of the defective surface layer with attendant reduction
of the number of elementary reflecting facets and thus decreasing multiple
reflection. Evaporation of the B_4C abrasive from the defective sapphire sur-

face layer during annealing contributes to this change in transparence and
integral transmittivity. Figures 1; tables 1; references: 8 Russian.
[113-2415]

EFFECT OF ION TREATMENT OF SUBSTRATES ON INITIAL STAGE OF BUILDUP OF METAL
FILMS

STEPURO, A. V., TUROVSKAYA, T. S., MURANOVA, G. A. and PERVEYEV, A. F.

[Abstract] A study was made for the purpose of determining the effect of
purifying ion bombardment of substrates on nucleation and buildup of metal
films. In the experiment such a pretreatment of quartz and K8 glass substrates
and subsequent deposition of aluminum, copper and silver films by vacuum evapo-
ration or cathode sputtering took place in a continuous technological cycle
without opening of the vacuum chamber (URM 3.279.011, YS-776 "Veeco", A-400-
VI "Leybold-Heraues"). The substrates were bombarded with 1.0-1.5 keV argon
ions with a current density of 1.0 mA/cm^2 and a surface blasting rate of
1 μm/h. Ion bombardment was found to activate the glass surface and produce
free surface bonds, the latter providing artificial nucleation centers for
metal films and subsequently increasing the film adhesion. When metal films
are deposited by cathode sputtering, their molecules are more likely to
migrate over the substrate and merge with the undesirable effect of increasing
the dimensional variance of film nuclei. This, and heating of the substrate as
a result of long ion blast, make it necessary in addition to treat substrates
with a short ion polish just prior to film deposition. It is thus possible,
by means of ion treatment, to control the film deposition process as well as
to produce films with uniform thickness (copper films 1000-3500 Å thick) and
uniform structure ensuring minimal or no scattering of light. Figures 3;
tables 1; references 21: 3 Russian, 18 Western (1 in Russian translation).
[113-2415]

FEATURES CHARACTERISTIC OF POLISHING ALUMINUM ALLOYS AND COPPER FOR MIRRORS

NAZAROV, Yu. F. and RUBAN, V. M.

[Abstract] An experimental study was made for the purpose of determining the
effect of surface treatment by various methods on the optical reflectivity of
flat rolled copper (M1) and aluminum alloys (AMg-3, D16). Four methods of sur-
face treatment were evaluated: 1) milling with Elbor; 2) milling with hard
alloy; 3) grinding with diamond abrasive; 4) electrochemical polishing in 40%
H_2SO_4 + 40% H_3PO_4 + 6% CrO_3 + 14% H_2O electrolyte at 60-70°C (aluminum alloys)
or in 900-1200 g/dm^3 H_3PO_4 + 100-150 g/dm^3 CrO_3 electrolyte at 18-30°C with the
current density varied from 10 to 50 A/dm^2 in each case. The surface roughness
in terms of rms asperity heights and the integral reflection coefficient over
the 0.3-2.5 μm range of wavelengths were measured before and after treatment,
a silver mirror with a 0.84 reflection coefficient serving as photometric
reference. The results have established a correlation between decrease of
roughness and increase of the reflection coefficient, this correlation becoming
stronger with increasing current density before buildup of a passivating film
in the case of electro-chemical polishing. Milling with Elbor was found to be
much more effective than milling with hard alloy for producing highly reflective
surfaces. Figures 4; tables 1; references: 2 Russian.
[113-2415]

DEPENDENCE OF RELATIVE HARDNESS-IN-GRINDING OF OPTICAL GLASSES ON GRADE OF
ABRASIVE MATERIAL

KRYUKOVA, S. V. and BONDAR', V. V.

[Abstract] Relative hardness-in-grinding is defined for optical glass as the
ratio of its volume ground away to that of K8 glass. A series of tests and
measurements was made in a grinding machine with cast-iron arbor and inter-
changeable wheels for determining the dependence of this hardness indicator on
the microhardness of the abrasive. Specimens of 18 optical aluminoborosilicate
glasses, low-silica grades softer than K8 glass and high-silica grades harder
than K8 glass, were ground under a pressure of $5 \cdot 10^4$ Pa at a circumferential
velocity of 4 m/s. Grinding was done with two abrasives, white electrocorundum
and green silicon carbide of M28 grain size both with respectively 2000-2100
and 3300-3600 kgf/mm^2 microhardness. An evaluation of the data reveals that

using a softer abrasive increases the relative hardness of glasses harder than
K8 glass and decreases the relative hardness of glasses softer than k' glass.
The results do not indicate an increase of grinding process productivity pro-
portional to the increase of abrasive microhardness but rather a principal role
of the glass microhardness, namely that the effectiveness of a harder abrasive
increases with increasing glass microhardness. Figures 1; tables 2;
references: 10 Russian.
[113-2415]

INSPECTION OF CATHODE SPUTTERING PROCESSES BY MEANS OF QUARTZ RESONATOR

CHUTKO, V. M.

[Abstract] Direct inspection of the surface profile during cathode sputtering
by interferometric or other methods yields incorrect results when distortions
occur caused by heating of the target under ion bombardment. Measuring a
parameter proportional to the amount of sputtered target material with a quartz
resonator, i.e., measuring the shift of its resonance frequency caused by addi-
tion of the mass of target particles precipitating on its surface, is much
more accurate, if the resonator plate is shielded from external electromagnetic
fields and from charged particles. The small size of a thin quartz plate and
the high sensitivity of frequency measurement contribute to versatility and
adaptability of this method. The number of precipitating particles depends
largely on their distribution in the sputtering chamber and on the orientation
of the quartz plate relative to the particle beam. A quantitative relation
taking this into account is established here by analysis of the sputtering
process and by calculating the dependence of the particle precipitation rate
on the mass of eroded target material and thus also on the ion flux density.
This dependence is found to be nonlinear in the general case of arbitrary target
shape or arbitrary quartz plate orientation. For practical usefulness, there-
fore, this dependence must be maximally linearized by proper adjustment of
sputtering process parameters and resonator geometry. Figures 1; references 6:
2 Russian, 4 Western (1 in Russian translation).
[113-2415]

UDC 681.7.054

DESIGNS OF EQUIPMENT AND METHODS OF TECHNOLOGICAL STRESS RELIEF OF LARGE
OPTICAL COMPONENTS

LEONT'YEV, A. A. and GUZMAN, V. Ye.

[Abstract] During machining of large optical components, stresses produced
in the material by dead weight as well as by static and dynamic loads are the
major cause of subsequent imprecision in assembly and performance. Maintaining
each element in its location and compensating for all possible strains requires
special support and stress relieving systems in most situations, including
horizontal mounting. Accordingly, large high-precision mirrors are being
designed together with staff mounts as integral functional systems. Supports
and stress relieving devices for such mirrors must have some overload capacity
in order to withstand additional loads during grinding and must accommodate
special bushings and fasteners. Technologically such systems include mechani-
cal, hydraulic, pneumatic ones or combinations thereof. According to their
mode of operation, they are basically either axial or radial. Essential ele-
ments in any of these systems include rubber pivots, resin springs, resin
bellows, planetary bearings, cushion rings, corrugated membranes. Elaborate
support and stress relieving systems have been appropriately designed and
built for telescope mirrors with diameters ranging from 450 mm to 6 m (BTA),
including such as the 3.8-m mirror in the Keet Peak Observatory and the 5-m
mirror in the Mt. Palomar Observatory. Figures 11; references 28: 20 Russian,
8 Western (1 in Russian translation).
[113-2415]

UDC 534.341.001.572

LARGE-SIGNAL AMPLIFIER BASED ON FERRIMAGNETIC ECHO

YEGOROV, Ye. A. and KOZLOV, V. A.

[Abstract] An echo produced by interaction of natural spin modes in a non-
ellipsoidal ferrite single crystal, following its excitation by two short
microwave pulses in succession, can be utilized for amplification. The perform-
ance of such an amplifier in the small-signal mode has already been analyzed.
Here large-signal amplification with attendant nonlinearity effects are
analyzed, upon solution of the corresponding Landau-Lifshits equation in
rectangular coordinates by the perturbation method. The solution is sought
in the form of a power series in the normalized magnetization amplitude after
the first excitation pulse. On the basis of this solution the dependence has
been calculated of the first-echo gain on the first-signal power P_1, that

power having been normalized to the second-signal (pumping) power P_2, and the gain found to be maximum at $P_1/P_2 = 10^{-11}$. The dependence of the first-echo gain and the second-echo gain on the time interval between the two input signals has also been calculated, both gains found to be peaking sharply but the corresponding time interval is shorter for the first-echo gain than for the second-echo gain. Such gain measurements on experimental YIG single crystals have yielded data for determining their identifying parameters. Figures 1; references 9: 5 Russian, 4 Western (1 in Russian translation).
[118-2415]

CIRCUIT ENGINEERING PRINCIPLES FOR CONSTRUCTION OF BIPOLAR LARGE-SCALE
INTEGRATED CIRCUIT STORAGE DEVICES AND VERY LARGE-SCALE MAIN MEMORY

ORLIKOVSKIY, A. A., NEKLYUDOV, V. A., SAVENKOV, V. N. and SERGEYEV, A. G.,
Moscow Institute of Electronic Engineering

[Abstract] Memories can be improved by increasing speed or the memory volume
on a single chip. The most effective means for increasing speeds in bipolar
memories are current control circuits with the lowest extraction times for a
specific power consumption ($1 \div 4$ pJ/bit). The control current circuitry
involves multistage current switches and circuits accelerating transient pro-
cesses in storage elements and links. The study analyzes circuit principles
for the design of bipolar memories with maximum speeds for an assigned minimum
of circuit topology. Two main classes of storage with current control are
considered: the ECL type and super-integrated injection type storage with data
capacities of $N = 1 \div 4$ kbit and $N > 4 \div 16$ kbit, respectively. The circuits
reduce logic voltage differentials and the volumes of lexical and discharge
buses and control circuit buses. The limiting speed is determined by the anti-
interference requirements of the memory in storage and extraction modes. For
a data volume of $N > 16$ kbit, the memory should be organized in individual
blocks with dimensions determined by speed constraints and chip space, but
speed can be increased by 30-40%. The I^2L storage is faster than the ECL for
larger storage capacities and also uses less power and space. Figures 3;
tables 2; references 11: 6 Russian, 5 Western.
[95-12497]

ART OF PROGRAMMING PROGRAMMABLE MICROCALCULATORS, PART 8: NUMERICAL SOLUTION
OF NONLINEAR EQUATIONS

TROKHIMENKO, Ya. K. and LYUBICH, F. D.

[Abstract] Programming of microcalculators programmable in the YaMK34 input
language is demonstrated on 12 programs for numerical solution of nonlinear
equations. Program 1/34 yields the roots x^* of equations $f(x) = 0$ accurately
to the m-th place by Newton's method of tangents $x_{i+1} = x_i - f(\dot{x}_i)/f'(\dot{x}_i)$,
program 2/34 yields these roots by the same method with numerical differentia-
tion. Program 3/34 yields the roots x^* of equations $x = \varphi(x)$, for example
$2^x - 5x - 3 = 0$, correctly to the seventh place by the method of straight inter-
ations. Program 4/34 yields the roots x^* of equations $f(x) = 0$ with maximum
accuracy by the method of successive halving. Program 5/34 yields the roots
x^* of the equation $f(x) = 0$ by the method of uniform sequential search. Pro-
gram 6/34 solves the equation $a_1x^2 + a_1x + a_0 = 0$ with highly accurate evalua-
tion of its positive roots by the Horner method. Program 7/34 solves the equa-
tion $x^3 + a_2x^2 + a_1x + a_0 = 0$, program 8/34 solves the equation $x^4 + a_3x^3 +
+a_2x^2 + a_1x + a_0 = 0$, program 9/34 solves the equation $x^5 + a_4x^4 + a_3x^3 +
+ a_2x^2 + a_1x + a_0 = 0$. Program 10/34 calculates the factor $(x^2 + b_1x + b_0)$ of
the polynomial $x^6 + a_5x^5 + a_4x^4 + a_3x^3 + a_2x^2 + a_1x + a_0$. Program 11/34 yields
the coefficients in the quotient $D(x) = A(x)/(x^2 + b_1x + b_0)$ and the remainder
$r_1x + r_0$ for polynomials of degrees not higher than ninth. Program 12/34 yields
the real root x^* of an algebraic equation with normalized ($a_n = 1$) polynomial
of odd degree not higher than elevenths and the coefficients in the quotient
$B(x) = A(x)/x-x^*)$. References 4: 3 Russian, 1 Western (in Russian translation).
[118-2415]

CONVERTERS OF SPATIAL CODING WITH INFORMATION DISPLACEMENT

KASIMZADE, M. S. and TIL'MAN, B. A.

[Abstract] In connecting analog source of information with an electronic
computer in technical process control systems, an important role is played by
various types of analog-digital converters of displacement into code. This
paper describes converters in which an original method of read-out is used,

based on the electric displacement of the threshold of operation, of a level
equivalent to the space displacement of sensitive elements. The method of
information displacement can be used in fields of technology connected with a
fixed position in space, particularly in navigation, robot structure (machines
with numerically programmed control), and as secondary converters--in measure-
ments of pressure, temperature, etc. It is possible to simplify the design
of converters and to increase the resolution. At present, work is conducted
at the Azerbaydzhan Scientific-Research Institute of Power Engineering on
information-measuring systems in which one of the possible realizaztions of
the method of information displacement is used. Figures 3; references:
3 Russian.
[126-6415]

ELECTRICAL INSULATION

DIELECTRIC-GRATING BAND-PASS FILTERS

VODOLAZHENKO, A. V. and KAZANSKIY, V. B.

[Abstract] The performance and band-pass characteristic of open dielectric
waveguide resonators are analyzed theoretically, considering an infinite
periodic (along the y-axis) grating of parallel ideally conducting identical
rectangular bars separated by dielectric waveguide channels. The structure is
symmetric with respect to the xy-plane and the height of the bars is fixed.
The width of the dielectric channels is fixed, but their height and the
dielectric material are controllable. Calculations are made for a horizontal
grating excited from above by a plane monochromatic wave with an H-vector
only parallel to the conductors and propagating at an arbitrary angle to the
vertical z-axis. The corresponding diffraction problem is solved for the
Fourier series coefficients characterizing the scattered field and for the
amplitude-frequency characteristic of the grating. Most important practically
is the case of an incident field with a wavelength equal to or larger than the
grating period. Solution of the problem by the numerical method of reduction,
the order of reduction depending on accuracy criteria in satisfying the bound-
ary conditions and the reciprocity theorem as well as the law of energy con-
servation, reveals that the dielectric filler modifies the amplitude-frequency
characteristic in three ways: by shifting the resonance frequency, by adding
interference effects produced as a result of multiple reflections at extra
interdielectric boundaries, and by changing the sharpness of the resonance
peak and thus also the slope of the curve as a result of coupling between
nearby dielectric channels. There are also revealed small-scale amplitude
oscillations within the pass band whose parameters depend on the selection and
the sharpness of "autonomous" resonances determining the pass band. Figures 3;
references: 10 Russian.
[118-2415]

RESONANCE CHARACTERISTICS OF DIELECTRIC SPHERE IN WAVEGUIDE

IL'CHENKO, M. Ye. and TRUBIN, A. A.

[Abstract] For some waveguides an open resonator in the form of a dielectric
sphere is preferable to one in the form of a dielectric disk. The resonance
characteristics of a dielectric sphere inside a rectangular waveguide have
been calculated from the solution to the characteristic equations for magnetic
and electric oscillations, respectively. The problem was solved using the
Wronskians of spherical functions and of Riccati-Bessel functions. Numerical
results are shown for sphere materials with the dielectric constant ranging
from 20 to 90, for H_{101}, H_{102} magnetic modes and E_{101}, E_{102} electric modes.
The results indicate that using the model of a magnetic wall leads to large
errors in calculation of the coupling for the E_{101} electric mode. Figures 1;
tables 1; references: 2 Russian.
[118-2415]

ELECTRON DEVICES

EFFECT OF PHASE TRANSFORMATIONS ON HEIGHT OF BARDEEN BARRIER IN METAL-GALLIUM ARSENIDE CONTACTS

IONOVA, Ye. N., KOLUPAYEV, I. N., PALATNIK, L. S. and FEDORENKO, A. I.,
Khar'kov Polytechnical Institute

[Abstract] The effects of phase formation at the metal-GaAs boundary on
Bardeen barrier height are studied for five metals (Au, Pt, Pd, Cu, In) with
different degrees of fusion with GaAs thus varying the metal-semiconductor
boundary. A thin layer (approximately 100 nm) was laid down on the semiconductor substrate in a high vacuum at room temperature. The phase states were
examined by electron microscopy and X-ray diffractometry for the original condition after heating to 500°C in a vacuum for one hour. Electric diffusion
interaction effects at the metal-GaAs barrier structures were estimated. For
all metals, heating produced intensive diffusion interaction with the formation
of intermediate stages but, in all cases, the height of the Bardeen barriers
remained practically the same as before heating. The surface states controlling
the electric characteristics were experimentally shown to be formed by the
initial stage of surface adsorption of metals. Figures 2; tables 1;
references 4: 1 Russian, 3 Western (1 in Russian translation).
[95-12497]

COLD-CATHODE GAS-DISCHARGE MODULATOR POWER TUBE

ANDRONOVA, V. P., ARSH, A. M., KRIZHANOVSKIY, V. I., KUZ'MICHEV, A. I. and
SHENDAKOV, A. I.

[Abstract] A cold-cathode gas-discharge tube has been developed for pulse
modulation of voltage in such devices as generators of pulse currents and
voltages with capacitive or inductive energy storage. Its operation is based
on magnetic control of space ionization, with the glow region under conditions
corresponding to the left-hand branch of the Paschen curve. These features

ensure reliable and stable performance, a cold cathode without heater filament saving both energy losses and warmup time. The basic structure of this tube is a coaxial configuration of cylindrical electrodes, with the cathode outside and the anode inside. The electrodes are both made of Kh18N10T stainless steel, both 2 mm thick and, respectively, 120 and 100 mm in diameter. The active length of the tube is 200 mm. A longitudinal magnetic control field is produced in the interelectrode space and, as the magnetic induction reaches its critical level, discharge is ignited just after a positive voltage pulse has been applied to the ignition stabilizing circuit. The maximum anode voltage is 15 kV, current pulses of 20-200 μs duration can be generated and a current of at least 1 kA can be interrupted under full voltage at repetition rates of 0.1-200 Hz with a fall time not exceeding 5 μs. The performance characteristics of this tube are superior to those of the GMI-37A hot-cathode pulse modulator tube, including a longer than 1000 h life. References: 2 Russian.
[118-2415]

ELIMINATION OF EFFECT OF NONIDENTITY OF SIGNAL FORMS ON PRECISION OF OPTOELECTRONIC DEVICES

SOLDATOV, V. P.

[Abstract] One of the major reasons for deterioration of the precision of goniometers and power optoelectronic devices is a change of the form of the optical signal. The effect of nonidentity of the form of signals on the precision of widely-used two-channel optoelectronic goniometers, operating according to the principle of successive comparison of the radiation flow in the two channels, is especially important. In order to eliminate this nonidentity, it is proposed to use a synchronous method for processing a signal, making it possible to obtain a gain in the signal-to-noise ratio in the presence of noise and the insensibility to the variations of rotation of the modulator. A block diagram of the goniometer is presented. Figures 3; references: 3 Russian.
[126-6415]

INDUSTRIAL ELECTRONICS AND CONTROL INSTRUMENTATION

BASIC TRENDS IN ECONOMIZATION OF LABOR AND MATERIAL RESOURCES IN ELECTRICAL
MACHINE MANUFACTURING INDUSTRIES

ZHUKOV, Yu. N., director, All-Union Design Engineering Institute of Electrical
Equipment Manufacturing Technology

[Abstract] The main trends in economization of labor and materials in the
electrical equipment manufacturing industry are introduction of low-waste
technology and automation of respective processes with use of high-productivity
facilities. The systematic comprehensive program covers progressive casting
and die forging, installation of industrial robots, automation of mechanical
forming operations by numerical program control of machine tools, electrical
treatment and progressive methods of tool and die hardening, transportation
and warehouse activities. Equipment already operating with numerical program
control includes "Kristall" and "Yenisey" plasma-beam cutters. While the
production volume is increasing, the labor content is decreasing by as much as
20-34% upon introduction of flexible automatic production complexes.
Typically, 15 such complexes have been installed in pressure casting plants
where induction furnaces will produce up to 50,000 tons of cast iron by 1985.
With continuation of this trend in the electrical equipment manufacturing
industry, the end of the current Five-Year-Plan period will see more better-
quality production with 20% less manual labor.
[112-2415]

INTRODUCTION OF LOW-WASTE AND METAL-SAVING TECHNOLOGICAL PROCESSES IN
ENTERPRISES OF ELECTRICAL INDUSTRY

SAPRYKIN, I. A., candidate of technical sciences, All-Union Design Engineering
Institute of Electrical Equipment Manufacturing Technology

[Abstract] Low-waste technology includes plasma-beam metal cutting, special
casting processes, progressive cold and hot extrusion, rolling, pressing, and
other processes, all designed for maximum metal economy. Their effectiveness

depends on their yielding blanks most nearly approximating the shapes and sizes of finished parts, which is attainable by systematic introduction of these processes into respective enterprises. This is planned, along with appropriate mechanization and automation, for the electrical equipment industry. According to schedule, 17 special-purpose production complexes including such equipment as "Kristall TP-2.5" plasma-beam cutters with program control and "Kvant-16" laser heaters should be installed by 1985 in at least 10 enterprises. This should save 3 million rubles and 20,000 tons of steel (500 tons of tool steel) annually, while reducing the labor force by approximately 1000 workers, toward the end of the current Five-Year-Plan period.
[112-2415]

ADVANCED TECHNOLOGY AND MECHANIZATION--MOST IMPORTANT CONDITIONS FOR HIGHER PRODUCTIVITY

LEBEDENKO, V. A., candidate of economic sciences, All-Union Scientific Research Institute of Electrical Equipment Manufacture

[Abstract] The effect of advanced technology and mechanization on low-voltage equipment manufacturing is evaluated in terms of higher productivity, longer product life, better material economy, and reduction of manual labor. Items of particular interest are replacement of metals with cermets produced by powder metallurgy, for mechanical and structural components, replacement of thermosets with thermoplastics and molding under lower pressures, installation of microcomputers ("Elektronika-60") for machine-tool control and product inspection. Already by 1985 there should be realized a large reduction of manual labor and man-hours along various production phases, but especially in machine-tool operation and in coil insulation-molding where respectively up to 1000 and 2000 workers can be eliminated. Figures 2.
[112-2415]

PROGRESSIVE TECHNOLOGY OF SURFACE FINISHING

GORDON, G. A., engineer, LEVENGARTS, V. L., engineer, POLEZHAYEV, V. V., engineer, and PRIZANT, A. Ya., engineer, All-Union Design Engineering Institute of Electrical Equipment Manufacturing Technology

[Abstract] Latest progress in surface finishing technology has been made by introduction of the VS-300M vibration machine consisting of an unbalance-type exciter and a chamber, the latter filled with granules which by tumbling

and colliding with a treated part produce the required rough or fine surface finish. The volume of the chamber is 0.31 m^3, adequate for processing parts up to 150 x 150 x 50 mm^3 in size, the exciter is driven by a 5.5 kW electric motor. The vibration amplitude can be regulated up to 3 mm, at frequencies of either 25 or 36.6 Hz. When used for treating steel parts, the machine can process up to 300 kg/h for a rough surface finish and 75-100 kg/h for a fine surface finish. Another representative of latest progress in surface finishing technology is a microprofile regularizing machine where a special tool such as a ball or diamond tip moves in an oscillatory pattern while pressing against the surface of a metal part and plastically deforming its surface layers to a smooth finish. Vibration treatment is to be installed in 50 product lines and microrelief regularization is to be installed in 15 product lines, altogether in 30 electrical equipment manufacturing plants with an estimated 600-700 thousand rubles annual cost reduction. Figures 4; tables 2.
[112-2415]

HYDROMECHANICAL DEEP DRAWING--PROGRESSIVE PROCESSING OF HOLLOW PARTS

PETROV, V. V., engineer, PESOK, M. L., engineer, MEYERSON, I. G., engineer, and NOGIN, V. S., engineer, All-Union Design Engineering Institute of Electrical Equipment Manufacturing Technology

[Abstract] Hollow parts are now produced basically either by spinning or by deep drawing. Spinning requires a combination lathe and press, deep drawing requires special dies and a general-purpose press. The advantages of spinning are larger deformation per pass and finer surface finish, also adaptability to more intricate shapes, its disadvantages being that it requires more time per operation and can produce only axisymmetric parts. A recent development has been hydromechanical deep drawing, which combines the advantages of spinning without its disadvantages. The equipment includes a chamber with working fluid which consists of an open vessel and a die on top with seals between them, a plunger, a clamping cover on the die with clearance for fluid displacement and metal extrusion, and a pressure holder-regulator with valves. Hydromechanical deep drawing has been introduced abroad, but not enough data are available yet to indicate its economic feasibility in Soviet industry. Only its technical feasibility has been established so far, on the basis of theoretical force and stress analysis as well as experimental performance evaluation with a laboratory apparatus. Among its favorable features are useful friction between plunger and blank part, low harmful friction between die and blank part, possibility of producing parts with uniform wall thickness and of irregular intricate shapes with high precision, also parts made of high-strength metals or alloys with poor plasticity characteristics as well as of metals or alloys prone to seizing. On the basis of trial production of 1.0 mm thick parts of AD1M aluminum alloy and 1.2 mm thick parts of 0.8kp steel. it can be estimated that introduction of this process and equipment will yield a cost reduction of 25-35 thousand rubles annually in one plant. Figures 3; references 7: 6 Russian, 1 Western.
[112-2415]

SPHERICAL PRESSING OF HIGH-PRECISION PARTS FOR ELECTRIC LOCOMOTIVES

BABUSHKIN, R. A., engineer, SDOBIN, V. A., engineer, and SAPRYKIN, I. A., candidate of technical sciences, All-Union Design Engineering Institute of Electrical Equipment Manufacturing Technology

[Abstract] Spherical pressing is used successfully for producing various bulky high-precision parts such as covers, flanges, and pinions for electric locomotives. The gist of this process is pressing on a blank part with a tool while circular oscillatory motion occurs. This can be achieved in three modes: 1) oscillatory and forward (downward) motion of plunger; 2) oscillatory motion of plunger and forward (upward) motion of die; 3) oscillatory motion of die and forward (downward) motion of plunger. Such an operation requires special equipment where the pressing force varies with the inclination angle of the cam driver. Three presses are available, the DB2432 with a nominal force of 1.6 MN (frequency of circular oscillations of cam driver 150 per minute, maximum driver inclination angle 3°, forward motion 75 mm/s idle and 2.7 mm/s under load) and two others with nominal force of 100 and 400 MN respectively and slightly different other performance parameters. These machines can process steel parts up to 100, 150, 200 mm in diameter, respectively, and copper or alloy parts up to 180, 220, 350 mm in diameter, respectively, with a 0.7-0.8 metal utilization factor, dimensional precision within $\pm$0.05 mm, and a 1.25-0.65 surface finish. On the basis of an annual production volume of 200,000 parts, they yield an annual cost saving of 45,000 rubles and metal saving of 220 tons. Figures 5; tables 1; references: 4 Russian.
[112-2415]

MECHANIZATION OF SHEET METAL STAMPING OF MAGNETIC CORES ON UNIVERSAL PRESSES

SARKISOV, R. T., engineer, All-Union Scientific Research and Technological Institute of Electrical Machinery, Baku branch

[Abstract] Stamping laminations of magnetic steel for electric machines is being mechanized and automated so that it can be done with suitable universal press. Accordingly, two production lines have been designed and build: the LMR-330 for stamping rotor laminations up to 330 mm in diameter and the LM-740 for stamping stator laminations up to 740 mm in outside dimension from a reel of sheet steel. Both lines operate with conveyor belts, most operations, which include loading, unloading, and scrap handling, are performed automatically and controlled electrically through electromagnetic relays. The

LM-740 line is already installed at the Electromechanical Manufacturing Plant imeni Vladimir Il'ich in Moscow, it saves 176,000 rubles and 368 tons of magnetic sheet steel annually with manual labor reduced by 4 workers. The LMR-330 line will be installed in this plant, it should save 12,800 rubles annually with manual labor for operating three presses reduced by 13 workers. Figures 2.
[112-2415]

USE OF MICROPROCESSORS FOR CONTROLLING FREQUENCY-CONTROLLABLE INDUCTION MOTORS BY WAY OF FREQUENCY CONVERSION WITH DIRECT COUPLING

PEREL'MUTER, V. M., candidate of technical sciences, Scientific Research Institute at Industrial Association, Kharkov Electromechanical Plant

[Abstract] Microprocessors are increasingly used for automatic thyristor control of a.c. motors. An important application is control of squirrel-cage induction motors through frequency conversion with direct coupling. Such a control involves automatic regulation either by way of measuring the magnitude or the direction of the flux-linkage vector and regulating the stator current components, respectively parallel and perpendicular to that vector, or by way of regulating the frequency and the amplitude of the stator currents. The operation of a microprocessor performing these functions requires appropriate software and hardware. The principal calculations are those of currents and their phases from readings of emf, current, and flux-linkage transducers. A proportional-integral regulator is nost suitable for current and speed control, also flux linkage control when included. The computer should be preceded by a multichannel voltage (analog)-to-code converter and can be bypassed by the speed(analog)-to-code converter between motor shaft and speed regulator. The structure of the automatic regulation system must ensure appropriate signal flow and feedback around the motor, also the proper sequence of control events. Efficient high-speed direct digital control is feasible with a multi-processor, even with the necessary inclusion of several analog signals in the loop. Figures 2; references: 5 Russian.
[112-2415]

REGULATION OF MECHANICAL CHARACTERISTIC OF IRON-POWDER ELECTROMAGNETIC BRAKE

KHAYRULLIN, I. Kh., doctor of technical sciences, SYROMYATNIKOV, V. S.. doctor of technical sciences, ISMAGILOV, Sh. G., candidate of technical sciences, and SULTANGALEYEV, R. N., engineer, Ufa Institute of Aviation

[Abstract] Electromagnetic clutches and brakes operating with iron powder are used in aircraft instrumentation and automation systems because of their favorable performance indicators, particularly high ratio of braking torque to moment of inertia. The braking torque, also the running torque during slippage, can be treated as the sum of a magnetomechanical component (speed-independent interaction of iron particles with one another and with the rotor surface) and an electromagnetic component (speed-dependent interaction of magnetic field crossing the air gap to the rotor with addy currents induced in the rotor). It is feasible to regulate the corresponding mechanical (speed-torque) characteristic in order to achieve the optimum curve for a given drive system. The regulation system consists of an inductive transducer, a linear rectifier, a function regulator, a voltage divider, and a pulse-width modulator with the output pulse duration controllable by the ratio of pulse duration to switching period. Such a regulation system has been designed at the Institute of Aviation for a brake with variable poles and cylindrical low-inertia rotor mixing iron powder in the air gap. Performance calculations indicate a linearly increasing parabolic speed-torque curve with a linearization error not exceeding 5%. Figures 4; references: 3 Russian. [112-2415]

OPERATING MODES OF SUPERCONDUCTING CURRENT CONVERTERS IN SERVICE

IGNATOV, V. Ye., candidate of technical sciences, and SKOBARIKHIN, Yu. V., engineer, Institute of Power Engineering imeni G. M. Krzhizhanovskiy

[Abstract] The operation of a.c.-to-d.c. converters for superconducting inductive loads such as cryogenic electric machines or magnetic separators is analyzed from the standpoint of energy balance and performance characteristics. On the basis of theoretical relations and measurements made in an experimental test stand, respective curves have been calculated depicting the dependence of load current on number of converter cycles in two basic modes of operation: 1) energy flow from converter to motor; 2) energy flow from generator to converter. The results are useful for design purposes and indicate the feasibility of continuous-duty operation with "frozen in" energy flux in stationary power plants. Figures 4; tables 3; references 3: 2 Russian, 1 Western. [112-2415]

TECHNOLOGY OF PRODUCING THERMOSIPHONS FOR TRANSFORMER HEAT EXCHANGERS

BARANETSKIY, N. V., engineer, BOGOMOLOV, B. N., engineer, BRAYNIN, E. I., candidate of technical sciences, MORGUN, V. A., candidate of technical sciences, POLYAKOVA, A. I., engineer, and SENIN, V. V., engineer, All-Union Scientific Research Institute of Explosion-Proof and Mining Electrical Equipment; Special Design Office, Institute of Heat and Mass Transfer, BSSR Academy of Sciences

[Abstract] Heat transfer from active components of 1000 kVA - 6 kV explosion-proof substation transformers is facilitated by means of thermosiphons in the form of wickless heat pipes. The body of such a device is produced from a tube of M2r M copper ($\geq$ 35% elongation) 16 mm in diameter with 1 mm wall thickness, by setting it under a press to a thickness of 7 mm after both inside and outside surfaces have been chemically treated. This is followed by a flattening operation and argon-arc d.c. welding with a nonfusible tungsten electrode at the bottom end. Thermosiphons are primed with boiling distilled water in a mechanized heating stand, a steam jet ejected into the atmosphere indicating completion of the process. After cooling, preferably by immersion in cold water for fast action, thermosiphons are inspected for "knocking" by shaking in the vertical and then again for "knocking" as well as for leakage after they have been dried for 1 h at 150°C. Final inspection takes place in a thermometric test stand with copper-constantan thermocouples. Already over 4,000 thermosiphons have been produced by this method with a stable high quality for experimental explosion-proof transformers. Figures 4; tables 1; references: 6 Russian.
[112-2415]

INFRARED ELLIPSOMETER METHOD FOR DETERMINATION OF PARAMETERS OF THIN
EPITAXIAL STRUCTURES WITH BURIED LAYER: SPECIMENS WITH DULL INACTIVE SURFACE

LONSKIY, E. S., VASIL'YEV, V. P.

[Abstract] In order to increase the efficiency of epitaxial structures with a
buried layer, methods are needed for the monitoring and analysis of the
technical processes involved in their construction. Nondestructive and
contactless infrared measuring methods are preferred for examination of
epitaxial film and can be applied to thin epitaxial structures with a buried
layer when, because of thickness and impurity concentration, the layer acts as
a semi-infinite absorbing substrate. The study analyzes the limits and pre-
cision of the infrared ellipsometer method. The model used is based on the
replacement of the buried layer in the structure by free carrier concentrations
and an infrared ellipsometer method is developed which leads to a model of the
real thin epitaxial structures with buried layers, and an approximation of the
buried layer doping profile. The distance of the layer from the surface, its
thickness and doping can be determined. The model is compared with experi-
mental results. Figures 6, tables 3, references 10: 8 Russian, 2 Western
(1 in Russian translation).
[95-12497]

WORK OF ALL-UNION SCIENTIFIC-RESEARCH INSTITUTE OF METROLOGY IN FIELD OF
PHOTOMETRY AND RADIOMETRY OF INFRARED RADIATION

BABUSHKIN, V. V.

[Abstract] This paper is a detailed account of the stages of development in
Russia of light and radiometric measurements, beginning with the work of
D. I. Mendeleyev who founded a photometric laboratory in 1901 at the Bureau
of Weights and Measures. Various standards introduced through the years are
described, and future work in the field of light and radiometric measurements
is considered. References: 12 Russian.
[126-6415]

NATIONAL SPECIAL STANDARD FOR TEMPERATURE UNIT CONCERNED WITH INFRARED
RADIATION

ANNO, B. I. and BABUSHKIN, V. V.

[Abstract] The reasons for the increasing value to industrial practice and
scientific research of temperature measurements in the infrared region of the
spectrum are presented. The National Special Standard for a temperature unit--
Kelvin--concerned with infrared radiations consists of a complex of special
equipment, including a model of the absolute black body with apparatus for
control and regulation of temperature; a group of three platinum rhodium-
platinum thermoelectric thermometers, a set of four temperature lamps, and a
photoelectric spectrocomparator. The principal technical characteristics are
shown in a table, and a detailed description is given of the units. The results
of an evaluation of the sources of systematic and random errors of the equipment
are listed in two tables. The planned path for further perfection of the stand-
ard is discussed. Candidate of Technical Sciences V. V. Babushkin, chief of a
laboratory of the All-Union Scientific-Research Institute of Metrology imeni
D. I. Mendeleyev is the scientific custodian of the standard. Figures 1;
tables 3; references: 6 Russian.
[126-6415]

NATIONAL PRIMARY STANDARD FOR UNITS OF FLUX AND FLUX DENSITY OF NEUTRONS

SHCHEBOLEV, V. T., RAMENDIK, Z. A., STUKOV, G. M., and KUTEYEVA, T. M.

[Abstract] In 1982 the National Committee of Standards of the Council of
Ministers, USSR (Gosstandart) confirmed as the National Primary Standard for
Units of Flux and Flux Density of Neutrons, a complex of measurement means,
developed and investigated at the All-Union Scientific-Research Institute of
Metrology imeni D. I. Mendelev. The new national standard was created in
exchange for two standards used earlier--the National Primary Standard for
Units of Flux, and the National Primary Standard for Flux Density of Neutrons.
It assures reproduction of units in the wide energy range of 4.10^{-21}--
$2.3.10^{-12}$ Joule (0.025 eV -- 14.5 MeV) which corresponds to contemporary
requirements. During creation of the standard complex in the area of neutron
measurements, means of measurement existing earlier were modernized, and new
standard installations, means of recording and automized processing of measur-
ing information were developed and investigated. The national primary standard
contains the standard installations UEN-1, UEN-2, UEN-3, UEPPN, UEPTN and an

IDN-10 set of active detectors and radio-nuclear sources of neutrons. These units are described. Candidate of Technical Sciences V. T. Shchebolev was appointed as the scientific custodian of the standard. References 15: 14 Russian, 1 Western.
[126-6415]

PHASE LIGHT RANGE FINDER

NIZHENSKIY, A. D., VOLKONSKIY, V. B., ZHUKINSKIY, I. N., KODRYANSKIY, V. M., KONONENKO, A. G., MASYURENKO, Yu. A., POPOV, Yu. V. and YAKOVLEV, V. V.

[Abstract] One of the complex technical problems solved with the assistance of a plane light finder is monitoring of the geometrical dimensions of the antennas of radiotelescopes with large diameters (greater than 25 meters), intended for radioastronomy investigations. The assigned technical character-istics of the radiotelescope and the effectiveness of its operation are assured by regulation of the antenna profile by the results of measurements of the distance from one fixed point to check points on the surface of the parabolic mirror, the number of which can amount to several thousands. Monitoring of an antenna profile by this method provides for use of laser range finders which assure measuring of 10-100 meter distances with high precision (error of measurement 0.1--0.4 mm) and speed of response (measurement time--units of a second). A phase light range finder which satisfies the indicated requirements is considered and described in detail. Figures 1; references 4: 3 Russian, 1 Western.
[126-6415]

REFINEMENT OF CONCEPT 'SENSITIVITY' IN INTERFEROMETRY OF REFLECTING OBJECTS

VLASOV, N. G. and GALKIN, S. G.

[Abstract] Interference methods are widely used for investigation of reflect-ing objects: by checking of the dimensions and form, by measurement of the distribution of displacement on the surface of the object caused by the appli-cation of deforming loads, and calculation of deformations and strains. Objects with mirror reflecting surfaces are investigated with the aid of classical interferometry, and with mirror and diffusely reflecting surfaces-- by holographic and spectra interferometry. However, an analysis of sources in the literature shows that at present a definite, generally accepted determi-nation of the sensitivity of interferometers intended for investigation of

reflecting objects is absent. This does not make it possible, in particular, to compare interferometers of various types and to develop their metrological supply. The authors propose the concept "sensitivity" of interferometers of the types mentioned above on the basis of a standardized definition. Figures 1; references: 5 Russian.
[126-6415]

EFFECT OF DYNAMIC ERRORS OF RECORDING SYSTEM OF SPECTROPHOTOMETER ON CALCULATION OF COORDINATES OF COLORATION OF OBJECTS

LAGUTIN, V. I.

[Abstract] Relations are obtained which make it possible to evaluate the error of calculation of the coordinates of coloration, caused by the dynamic distortion of the spectrum of the object investigated. Formulas are proposed for evaluation of the maximum possible error. It is shown that the determining error is caused by a shift of the spectrum with respect to the scale of the wave lengths. Based on a recording system of the first order, it is shown how to obtain a formula for determining the feasible rate of scanning applicable to systems of an arbitrary structure. Tables 2; references 5: 3 Russian, 2 Western (1 in Russian translation).
[126-6415]

DIGITAL PHASEMETER FOR MONOPULSE RADIO SIGNALS

MAYEVSKIY, S. M. and FENDRIKOV, A. I.

[Abstract] A digital phasemeter is considered, intended for measurement of the phase and amplitude relationships of a radio pulse in any period of time assigned in advance. A block diagram and the principal technical characteristics of the phasemeter are presented. Figures 1; references: 4 Russian.
[126-6415]

MICROWAVE THEORY AND TECHNIQUES

MAKARENKO, A. A.

[Abstract] Microwave phase modulators are basically classified into linear
and discrete ones. The former are built with p-n diodes, Schottky-barrier
diodes, or IMPATT diodes. The latter are built with the same diodes, but
most often with p-i-n diodes. Although linear phase modulators can be designed
in two possible versions, namely as reflecting or transmitting phase shifters,
discrete phase modulators can also be designed in the form of phase shifters
with switching of channels or as combinations of low-pass filters and high-
pass filters. The main performance parameters of both types, determined
principally by those of the respective semiconductor diodes, are linearity
and slope of the modulation characteristic, nominal modulation index and level
of parasitic amplitude modulation, and range of modulating frequencies.
Other parameters common to both types are range of operating microwave fre-
quencies, power loss in the modulator, standing-wave ratio, control power, and
performance stability during fluctuations of ambient temperature or input power.
Discrete phase modulators are, in addition, characterized by a permissible
microwave input signal level, and the number and magnitude of phase discretiza-
tion steps for the given accuracy and speed requirements. The performance of
linear phase modulators can be improved by means of corrective networks con-
nected to the varactor which will minimize the parasitic amplitude modulation
and the nonlinearity of the phase modulation characteristic. However, the
narrow-band corrective networks needed for this purpose make it necessary to
connect more modulator stages in cascade so that the complexity of the device
increases even more. Discrete phase modulators are used successfully in
communication systems, as Doppler-effect simulators in radar, and as frequency
shifters in various measurement techniques. Figures 1; tables 1; references 35:
14 Russian, 21 Western (1 in Russian translation).
[118-2415]

PERFORMANCE CHARACTERISTICS OF COOLED SHIELDED STRIP LINES IN RANGE OF SHORT
MICROWAVES

BYSTROV, V. A., LYULICHEVA, I. A. and PAVLYUK, V. A.

[Abstract] The frequency dependence of the fundamental-mode phase velocity
and attenuation coefficient in a shielded and cooled strip line is calculated
from the dispersion characteristic and the field structure. Both are found
from the solution to corresponding paired integral equations for the longi-
tudinal current and the transverse current, with the field in the conductor
region and in the dielectric region represented as the superposition of LM-
modes and of LE-modes, respectively. The propagation constant is calculated
accordingly, whereupon the cutoff frequency for the first higher mode and its
dependence on the heometrical proportions of the strip line are also determined.
On this basis the effect is then interpreted of varying the thickness of the
dielectric substrate from zero to full waveguide height, and the corresponding
mechanism of generating quasi-TEM modes. Figures 3; references 5: 4 Russian,
1 Western.
[118-2415]

SATURATION EFFECTS AND NOISE DURING AMPLIFICATION OF WEAK SIGNALS IN
FERRITE-PARAMAGNETIC STRUCTURE

BALINSKIY, M. G. and DANILOV, V. V.

[Abstract] Amplification of microwave signals occurs in ferrite-paramagnetic
structures as a result of interaction between waves and the inverted spin
system in the paramagnetic crystal, with attendant compensation of losses by
magnetostatic waves but with the gain limited by saturation of the active
crystal. This effect was discovered and studied experimentally in YIG-ruby
structures at $T = 1.6$ K. This effect is demonstrated theoretically, assuming
a tangentially magnetized ferrite layer of finite thickness adjacent to a
paramagnetic half-space and a frequency of magnetostatic waves propagating
along the ferrite layer equal to that of the inverted signal transition.
Practical calculations were made for the fundamental mode of volume magneto-
static waves propagating in the direction of the constant internal magnetic
field in a cubic ferrite crystal, with the external constant magnetic field
parallel to the crystallographic [100]-axis of the ferrite crystal and to the
$\tilde{c}$-axis of the paramagnetic crystal. The product of gain G and ferrite thick-
ness S per unit length of the ferrite crystal, dependent on both frequency and
field intensity, is limited bilaterally: its upper limit is determined by the

saturating signal power density and its lower limit is determined by intrinsic noise. The equivalent input noise temperature is also dependent on both frequency and field intensity. Figures 1; references 5: 4 Russian, 1 Western (in Russian translation).
[118-2415]

ALTERNATING ACOUSTOELECTRIC CURRENT GENERATED BY INTERACTION OF TWO WAVES IN ACOUSTIC MICROWAVEGUIDE

BULAKH, G. I. and OSTROVSKIY, I. V.

[Abstract] An experimental study was made of electric currents alternating at a sum frequency and at difference frequency generated in acoustic micro-waveguides as a result of opposing and parallel interaction of two ultrasonic waves with attendant nonlinearity of electron concentration. Ultrasonic s_0-mode and α_1-mode Lamb waves were excited in CdS single-crystal wafers of micron thickness by two single-cell single-phase radiating transducers and electric signals were picked off two electrodes across a high-resistance load. The interaction space was illuminated with nonabsorbable light from an incandescent lamp through a yellow filter. Measurements revealed characteristic peaks in the dependence of both currents on the electrical conductivity of the crystal within the interaction space, the amplitudes of the corresponding voltages across the load differing appreciably from one another in magnitude and the ratio of the two voltages depending on both sum and difference frequencies. The difference-frequency voltage has been found to increase with decreasing difference frequency, very steeply to a maximum value equal to the sum of the two acoustoelectric voltages and remaining constant in time as the difference frequency approaches zero. This relation has practical applications in frequency comparators with tunable reference frequency. Figures 1; references 7: 3 Russian, 4 Western (1 in Russian translation).
[118-2415]

POWER ENGINEERING

PRODUCTION OF THIN-WALLED CASTINGS FOR ELECTRIC MOTORS BY DIE CASTING PROCESS

SIBIRTSEV, S. N., engineer, and SHVARTSMAN, R. I., engineer, All-Union Design
Engineering Institute of Electrical Equipment Manufacturing Technology

[Abstract] Die casting of aluminum parts is an important process in the
production of electric motors, specifically induction motors, but production
of thin-walled cast stator frames is not yet economically feasible with present
means. Full realization of its advantages requires mechanization of the
process with the use of automatic manipulators, introduction of advanced
technology with automatic control, development of new fluxes and degassers for
refinement of secondary aluminum alloys, and adaptation of nonferrous casting
facilities to the new techniques. Preliminary studies have established that
maximum metal economy in die casting of thin aluminum stator frames will be
achieved by operating the metal distribution furnace at 660-680°C, injecting
the metal with a ram velocity of 4.0-5.0 m/s and then pressurizing the mold
at 13-15 MPa, with not more than 20 ms lapse time from the end of injection
to the beginning of pressurization, and to allow 12.0-14.0 s time for
crystallization. The regulator of the melt movement must ensure nonturbulent
flow and a stable molding rate. The pressurization regulator must ensure a
smooth pressure rise without hydraulic shocks. The crystallization regulator
must optimize the crystallization time and the cooling time depending on the
metal temperature in the mold and on the power losses in the feeder. The
closing regulator must ensure a constant force independent of thermal strains
and must maintain a fixed "null" clearance so as to prevent breakage of dies
by protrusions or scrap pieces. Implementation of the new die casting process
has been formalized in three programs: 1) installation of commercial mechaniza-
tion systems KOM-1.25/2.5 in the machine area during the 1982-85 period;
2) installation of special-purpose casting systems for series AI motors with
shaft height dimension of 50-112 mm during the 1984-87 period; 3) starting a
pilot operation with new automatically controlled die casting system in 1985.
Subsequent full-scale operation of such die casting systems should increase
productivity by a factor of 2.3-3, reduce the consumption of nonferrous
alloys in this industry by 15-20%, and reduce, or in some cases eliminate,
machining of cast frames. Tables 1.
[120-2415]

TECHNOLOGY OF AND EQUIPMENT FOR DIE CASTING OF ROTORS

REBENKO, V. A., candidate of technical sciences, GOL'DBERG, I. Ye., candidate of technical sciences, and KURSKIY, D. M., candidate of technical sciences, All-Union Scientific Research Institute of Electrical Machinery Manufacturing Technology

[Abstract] A new technology of die casting has been developed, along with the necessary equipment, for rotors of induction motors with outside core diameters up to 180 mm. Rotor cores, stacked and then welded with an argon-arc along the inside shaft hole, are loaded into hoppers and from there dropped into molds, whereupon aluminum is poured either manually or with an automatic batcher (magnetodynamic batchers being most reliable and durable). The molds are opened after being held closed under pressure for an adequate length of time. The cast rotors are then transferred onto trays and moved by conveyor belt for subsequent trimming and assembly operations. The duration of one complete cycle with the L1R-180 mechanization system and an A711A08 casting machine is 45 s, regardless of the shape and the number of rotor slots. By casting several rotors simultaneously, the equipment can produce 180 rotors/h with a 3-cavity mold. It produces squirrel cages with an electrical conductivity not lower than 30 MS/m at 20°C. Installation of one such system should save 5 tons of aluminum annually and substantially reduce the manual labor, with a three-to-four times higher productivity.
[120-2415]

CALCULATION OF HYDRAULIC FRICTION LOSSES IN D.C. MOTORS FILLED WITH LIQUID DIELECTRIC

MOROZKIN, V. P., candidate of technical sciences, and TOKAREV, S. B., engineer, Moscow Institute of Power Engineering

[Abstract] Hydraulic friction during rotation of the armature in a d.c. motor filled with liquid dielectric is a major source of power loss, up to 40% of all power losses in such a motor. These losses are usually reduced by impregnating the end turns of armature coils with a compound and smoothing their outside surfaces. Hydraulic losses are best determined experimentally on a model armature and then calculated according to the theory of similarity for any other motor. This has been done with the armatures of DPK-8-3000, DPK-08-1000 small motors and P-42, Mu-52 large motors as test models. For subsequent calculations the armature is treated as a structure consisting of three

cylinders: 1) slotted wound active core rotating inside a stationary cylinder with a radial gap between them; 2) end turns of coils rotating in free space; and 3) slotted commutator rotating in free space. The back plate of the armature constitutes a rotating disk. Considering that the hydraulic drag coefficient is a function of the Reynolds number only, it is calculated for each component of the armature on the basis of semiempirical relations with length and radius, gap width between stator (field) bore and active rotor core, angular velocity or rpm, and density of the dielectric as parameters. The resultant hydraulic drag coefficient is found by weighted combining of the four partial ones, with use of diameter ratios and a length-to-diameter ratio for the active core. It is found to be generally an inverse-power function of the Reynolds number: $C_\Sigma = k_1 N_R^{-0.39}$ for $\log N_R < 5:14$ and $C_\Sigma = k_2 N_R^{-0.02}$ for $\log N_R \geq 5.14$, respectively. A refinement can be made by resolving the flow of the dielectric into axial and rotational components, the latter not being appreciable in large (P-42, Mu-52) motors, with corresponding two Reynolds numbers. Axial flow stabilizes the rotational motion and turbulence is retained throughout the range of the rotational Reynolds number with a smoother transition ($N_R^{-1.65}$ for $\log N_R < 5.57$ and $N_R^{-1.27}$ for $\log N_R \geq 5.57$) while the hydraulic drag coefficient becomes also a function of the kinematic viscosity alone. The analytical formulas thus obtained are accurate within 20%. Figures 1; references 4: 2 Russian, 2 Western.
[120-2415]

WAVEGUIDE CHARACTERISTICS OF RESONATORS WITH ARBITRARY DISTRIBUTION OF
DIELECTRIC PERMITTIVITY

LOGGINOV, A. S. and YUL'BERDIN, Yu. F.

[Abstract] A numerical method has been developed for calculating the trans-
verse modes in a semiconductor laser resonator with an arbitrary dielectric
permittivity profile. The method is based on the theory of injection lasers
and on the corresponding wave equation for the electric field component with
complex frequency and wave number. This equation is transformed into a
homogeneous system of linear algebraic equations in real and imaginary fre-
quency increments for a "convex" transverse inversion profile, normalized to
the threshold concentration of injected charge carriers, with a local non-
uniformity of the peak or valley kind. The determinant of that system of
equations is evaluated by equating both its real and imaginary parts to zero.
The corresponding eigenvalue problem is now solved numerically by Newton's
iteration method. The results reveal that a local inhomogeneity modifies the
spectrum of transverse modes corresponding to the unperturbed inversion pro-
file. Two groups of modes differing from one another and from the original
modes are found to exist, one group generated by the waveguide mechanism with
focusing of the radiation and one group generated by the nonuniformity
mechanism with smooth transformation into modes of a different order, the
height or depth of the nonuniformity determining which mechanism predominates
and energy transfer from one side to the other side of the inhomogeneity is
possible in the case of focusing. This interpretation is applied to a typical
specific case of an originally wide "convex" inversion profile acquiring a
local peak whose height varies sinusoidally and width varies cosinusoidally.
Figures 2; references 7: 4 Russian, 3 Western (1 in Russian translation).
[118-2415]

PECULIARITIES OF MEASURING TRANSFER FUNCTIONS OF COMPOUND IMAGING SYSTEMS

SHUL'MAN, M. Ya.

[Abstract] Various methods have been developed for measuring the optical
transfer function of compound imaging systems. An instrument for measuring the
modulation transfer function (contrast-frequency characteristic) or the phase
transfer function includes a light source, a periodic grating as a test object
a condensing lens, a collimating objective, the tested focusing objective with
a microobjective which facilitates operation with a wider slit and which pro-
jects the image enlargement on the plane of that slit. A photomultiplier-
receiver behind that slit generates electric measuring signals. Special
objectives are added to this instrument when the imaging system contains
electronic components. The principle of measurement is essentially the same
for systems consisting of independent components and for coupled multistage
systems, with the corresponding autocorrelation of the pupillary function
governed by different relations in each case. In the case of a multistage
system it is necessary to evaluate the effect of the measuring instrument com-
ponents, especially of the microobjective, on the transmission of light. Also
a diffraction quality of the image must be maintained here, by appropriate
proportioning of the various apertures and through minimization of aberrations.
A special kind of optical system is one containing fiber optics. On account
of the constraints imposed here by the peculiarities of the fiber structure,
it is recommended that measurements be made in arrays with a space period not
smaller than twice the pitch of the fiber structure and the analyzing slit be
not wider than half this pitch. Figures 2; tables 1; references 8: 7 Russian,
1 Western.
[113-2415]

METHOD OF MEASURING CONTRAST-FREQUENCY CHARACTERISTICS OF ELECTRON-OPTICAL
SYSTEMS

SEN', Yu. V., LEONOV, N. B., KRAVCHUK, G. S., TYUTIKOV, A. M. and
FLEGONTOV, Yu. A.

[Abstract] A method of automatically measuring the contrast-frequency char-
acteristics is described which involves using a dash-line template but does
not require mechanical scanning of the image. Dash-line patterns are projected
on the photocathode of a dissector operating in the unilateral-sweep mode dur-
ing photon or electron count. The effect of photoreceiver gain fluctuations
on the readings is eliminated by normalization of the photon pulse amplitude

and duration with a flip-flop multivibrator. An integrator forms the envelope of readings, which is proportional to the screen brightness at a given image point on the scanning axis, scanning the image of a single slit being more expedient than using several templates with different space periods. Evaluation of the frequency-contrast characteristic involves computer-aided Fourier transformation of the envelope into its harmonic components, multiplying those of the successive system components, and comparing the resultant amplitude with that corresponding to an ideal slit. The procedure was applied to the frequency-contrast characteristic of an electron-optical system consisting of a plate with microchannels and a plane electric field. The shape of the curve depicting the contrast-frequency characteristic depends in this case on the output current, on the integration constant, on the potential difference across the plate, on the potential difference between plate and screen, and on the diameter of channels in the plate. Dependence of the contrast on the orientation of the template-slit relative to the channels in the plate can be eliminated, within 5%, by using a slit with a width equal to at least three diameters of these channels. Figures 4; references 11: 10 Russian, 1 Western.
[113-2415]

FEASIBILITY OF AUTOMATIC PROCESSING OF INTERFEROGRAMS IN SYSTEM WITH CHARGE-TRANSFER-COUPLED ARRAYS BY COMPUTER SIMULATION

AGUROK, I. P.

[Abstract] Automatic processing of interferograms is possible with a television readout system consisting of a charge-transfer-coupled receiver array followed by an analog-to-digital converter and then a memory-computer set. This replaces an expensive television picture tube of the plumbicon type operating with short-duration strobing pulses and unavoidable "quicksand" distortions. The three main steps of the processing algorithm are: determining the overall interferogram dimensions as well as its radius and the coordinates of its center from the intensity of the reference light beam and the intensity gradient, then roughly calculating the coordinates of the fringe peaks, and finally refining those coordinates through iteration. The last step requires computer simulation of receiver output signals to the analog-to-digital converter, which is done by first approximating the wavefront distortion func- with Zernicke polynomials and then integrating by the Simpson method over nine receiver elements around a roughly located fringe peak. The expediency of this algorithm has been established on interferograms obtained with a Fizeau or Twyman-Green interferometer and by simulation on a YeS Unified System computer. An accuracy within 0.1% of a wavelength is attainable in the absence of noise, at a noise level equal to 1/32 of the signal level the algorithm loses its effectiveness after 2-3 refinement iterations, but a noise suppression to 1/128 of the signal level is feasible. Figures 2; tables 1; references 10: 7 Russian, 3 Western, in Russian translation.
[113-2415]

UDC 666.11.01:621.373.825

RADIATIVE STRENGTH OF MILK GLASSES

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, Nov 83
(manuscript received 3 Dec 82) pp 19-20

KADANER, G. I. and MURASHOV, V. V.

[Abstract] Light depolarizers for uniform illumination of photoreceiver pads
and Lambert scattering plates for calibrated attenuation of laser beams are
made of milk glass most suitable for a given application. In an experimental
study of two grades, MS13 and MS20, plane-parallel 1-mm thick plates were
tested for strength under radiation at 694 and 1060 nm wavelengths in pulses
of 25 and 40 ns duration respectively. After exposure to a radiation pulse,
a plate was brought close to a converging lens until a spark appeared, signi-
fying optical breakdown. The plate was then smoothly moved away to a distance
at which sparks resulted from only half the radiation pulses impinging on
various parts of the plate surface. In this situation the surface energy
density served as a measure of the ultimate radiative strength. The surface
energy density of radiation pulses at which the plate could withstand tens of
thousands of them served as a measure of the reliability limit. Both parame-
ters, namely the corresponding surface energy densities, were measured with
equipment consisting of a laser and a light splitter (plane-parallel plate of
K8 glass), the latter passing one part of the laser beam through neutral fil-
ters and the converging lens to the test specimen while reflecting the other
part of the laser beam through a reference specimen of milk glass to an FD24K
pulse integrating photocathode. The reference channel had been calibrated
against an IKT-1M calorimeter. The measurements of both strength and relia-
bility, both within +35% accuracy, indicate that MS13 glass is much preferable
to MS20 glass for diffusely reflecting screens, which should be at least 10 mm
thick, and for 2.0 mm thick depolarizing plates (or 0.5 mm thick MS14 glass).
Grinding the glass surface reduces its strength, polishing has little effect,
and chemical etching in a 27% HCl + 63% H_2SO_4 + 10% H_2O solution for 45 min

has been found to increase the strength by more than 20%. Figures 2; tables 1;
references 9: 7 Russian, 2 Western in Russian translation.
[113-2415]

UDC 681.7.067

DESIGN OF FRESNEL MIRROR OPTICS

Leningrad OPTIKO-MEKHANICHESKAYA PROMYSHLENNOST' in Russian No 11, Nov 83
(manuscript received 7 Feb 83) pp 22-23

BAKULIN, V. G.

[Abstract] Fresnel optics are considered for use in visual instruction equip-
ment, especially in image projectors. Particularly applicable are Fresnel
mirrors with reflective coating on the active facets and the light source facing

the carrier surface. The main design problem is to determine the angle between the generatrix of the usually conical facet and the usually plane carrier surface. This angle is calculated here on the basis of the system geometry including the path of light rays from source to its image, assuming operation in air with a refractive index n = 1, in a layout where the distances from the carrier plate to the source and to the image are much larger than the facet pitch and the distance from the carrier surface to the facet vertex. Figures 2; references 3: 2 Russian, 1 Western.
[113-2415]

ALIGNMENT OF MULTISTAGE LASER AMPLIFIERS WITH PERIODIC SPACE FILTRATION OF BEAM

ALEKSEYEV, V. N., NIKITIN, N. V., CHARUKHCHEV, A. V. and CHERNOV, V. N.

[Abstract] Multistage laser amplifiers with periodic space filtration of the beam, used for many applications as diverse as nonlinear spectroscopy and x-ray lithography, contain many optical components which must be aligned for optimum or even adequate performance. Except for computer-aided automatic alignment of parallel channels, most alignment is done manually, either directly or from a remote control panel. Alignment is complete when the apertures of all successive optical components have been centered within required accuracy in the direction of the laser beam. For this, along with the beam from the driving pulse source, there is also passed through the amplifier channel a continuous beam from an aligning laser with the same space structure and wavelength. The basic procedure is demonstrated on a single-channel amplifier with a Nd^{3+}-glass laser and several successive stages of planar optics, each preceded by a space filter, with an eyepiece behind the last stage. A space filter is a pair of confocal converging lenses in the window of a vacuum camera, the latter having a pinhole at the common focus of both lenses. Planar optics are Pockels shutters, Faraday valves, light-splitter mirrors, depending on the specific system. Alignment of each of these is facilitated by means of two diaphragms with 5-20 times smaller apertures, one immediately before and one immediately behind the optical element, forming Fresnel diffraction-ring images of the aligning beam. Alignment of the space filters, through pinholes sufficiently large to pass 10-30 Fraunhofer diffraction-ring images of the focused beam, is facilitated by means of diaphragms with 5-15 times smaller apertures on both sides of a filter. These diaphragms reduce the beam cross section and with the otherwise unmanageable aberrations. All apertures are aligned relative to a reference diaphragm through which both the driving beam and the aligning beam pass before entering the amplifier. Figures 2; references 7: 4 Russian, 3 Western (1 in Russian translation).
[113-2415]

FORMATION OF COLOR-CODED IMAGES FOR PHOTOGRAPHIC RECORDING UNDER SCANNING
ELECTRON MICROSCOPE

BALOBANOV, V. G., KAMALYAGIN, A. A., KULYAS, O. L., BOCHAROV, Ye. P. and
GOLOVENKIN, I. A.

[Abstract] A method of color coding of images is proposed which not only
yields the absolute magnitude of a video signal and reveals its constant
levels in the image plane but also ensures correct results of texture and
structure analysis. The coding algorithm provides for increasing the number
of visually perceptible image gradation levels without generating false
contours and without color oversaturation of the image. The equipment,
developed by the authors specifically for a photorecording video monitor with
a scanning electron microscope, consists of a differential input amplifier
followed by two limiters in parallel and these are followed by an electron
commutator switch between an input trigger and a video amplifier feeding a
penetron cathode-ray tube with a high-voltage electrostatic deflect'on system,
the latter including current correction and voltage switching during the beam
return stroke. This device utilizes the operating features of a photo-
recording video monitor and a scanning electron microscope, i.e., slow beam
sweep and possibility of sequential display of monochromatic images. With
controllable limiters there are possible three coding algorithms, the
optimum one corresponding to a limiter threshold lower than half the video
signal amplitude, but higher than zero. Figures 3; references 10: 9 Russian,
1 Western.
[113-2415]

CONTRAST AND COLOR CHARACTERISTICS OF LIQUID-CRYSTAL INDICATORS WITH TINTED
POLAROID COATINGS

GRUZDEVA, N. I., MINZHULIN, V. M., MIRONOVA, L. R. and TOMILIN, M. G.

[Abstract] Liquid crystals operating on the basis of the twist effect are
used as energy-efficient, compact, low-cost indicators for color display of
alpha-numeric information. An experimental study was made of such liquid
crystals with tinted polaroid film coating as a possible improvement of their
contrast and color characteristics. A set of four 25-mm high and 12-mm wide
dark symbols, each an appropriate combination of bars in the 7-bar ≡ figure
(each bar 12 mm long and 2.5 mm wide), was arranged to form a 4-digit number
in a light 96x55 mm^2 background frame. The liquid-crystal bars, each with

reflective coating on both sides, were each inserted between two glass sub-
strates carrying a polaroid film on the outside, the polaroid film on the
back side being covered with another reflective coating. The polaroid films
were blue, green, red, or colorless. Both symbol color and background color
were measured with an FM-104M photometer in a parallel light beam from a
colorimetric source at angles of 20 or 40°, the color being characterized by
tone (wavelength) and purity index, the color contrast being characterized
by the color difference, and the brightness contrast being characterized by
the brightness ratio. The results reveal that the effective color difference
(taking into account both color and brightness contrasts) between symbol and
background decreases with increasing illumination angle, most appreciably for
blue and green polaroid films and only slightly for colorless polaroid film.
The color difference between symbols is determined by their color contrast and
the color difference between backgrounds is determined by their brightness con-
trast, red and blue films showing the maximum color difference at a 20°
illumination angle. Red film is the optimum overall color-difference tradeoff.
Because the use of variously-tinted polaroid films reduces the brightness
contrast, which limits the range of acceptable illumination angles, the
usefulness of such liquid crystals is problematic. The authors thank
S. A. Studentsova for submitting specimens of liquid-crystal indicators for
investigation. Figures 2; tables 1; references 4: 3 Russian, 1 Western.
[113-2415]

DESIGN OF PROJECTOR MIRROR FOR OPERATION WITH HIGH-INTENSITY RADIATION SOURCE

SHTANDEL', S. K. and FUFURIN, V. N.

[Abstract] A paraboloidal projector mirror is designed for operation with a
DKs-El-250 1700-1800 nit high-intensity lamp ("point" filament 0.14-0.2 mm
long), with a focal length $f = 75$ mm and an embrace angle $2\varphi = 180°$. The
mirror surface is designed for aberration not exceeding a prescribed tolerance
band and for precise machining, to be inspected with an aberrograph, so as to
also minimize the axial force of the projector. The paths of light rays are
calculated with the light source first in the focus of this mirror and then
in the focus of the ideal mirror. On this basis a mirror generating curve is
established which will ensure parallel reflection of all rays by the real sur-
face. The axial force of a projector with a toroidal paraboloid mirror will
be 1.2-1.5 times larger than that of a projector with the ideal mirror.
Figures 3.
[113-2415]

SOLID STATE CIRCUITS

MODELLING OF TRANSFER PROCESSES IN MONOPOLAR SEMICONDUCTOR STRUCTURES WITH
SUBMICRON DIMENSIONS

KOKIN, A. A. and TOLSTIKHIN, V. I.

[Abstract] The increasing complexity of integrated circuits and the reduction
of logical elements to 1 micron or less require the modelling of submicron
dimension processes. The dimensions are commensurate with the scales determin-
ing semiconductor conductivity kinetics leading to special non-local and
nonlinear effects and the diffusion-drift Schockley equations are not adequate
even for channel lengths of approximately 1 micron and fields of approximately

10^4 V/cm. The study concerns the modelling of these processes and is limited
to n-type monopolar structures with highly mobile links which allow macroscopic
description of transfer processes by means of distribution functions. The
method is based upon the Boltzmann kinetic equation with a self-consistent
field and an analysis of electron-lattice interaction. A system of differen-
tial equations is given with boundaries determined by local equilibrium,
effective temperature and quasi-ballistic approximations. Unbalanced scale
effects, which are important for integrated circuit semiconductor elements,
are analyzed. The authors thank K. A. Valiyev for attention and support
rendered in the process of work on the paper. Figures 2; tables 3;
references 52: 24 Russian, 28 Western (2 in Russian translation).
[95-12497]

NEW ACTIVITIES, MISCELLANEOUS

CRYOSTAT FOR STUDY OF CIRCULAR DICHROISM

GRIGOR'YEV, Ya. M., OLENNIKOVA, L. V. and BARANOVA, G. I.

[Abstract] A cryostat has been built at the Leningrad State University for study of conformative equilibria by measurement of circular dichroism at cryogenic temperatures. Its optical components are adequately transparent for detection of weak bands in the normal absorption spectrum and the possibility of light beam depolarization, causing additional noise and reducing the sensitivi+·, is eliminated. The device consists of two parts made of stainless steel one inside the other, bolted together through Teflon washers and a Teflon sealing gasket. It has two pairs of CaF_2 windows, this material being less piezooptical than quartz. The windows are sealed with metallic indium. a vacuum of 10^{-1}-10^{-3} mm Hg is produced inside through a suction tube, the core is cooled with liquid nitrogen in a flask, and the temperature is set by an electric heater through an ETV-11A automatic regulator. Cooling from room temperature to -190°C can be achieved in one hour. Spectra can be recorded with this cryostat ranging from middle infrared (1200 cm^{-1}) to vacuum ultraviolet (180 nm). Spectra of circular dichroism have been determined with this cryostat for d-camphor in an ether-isopentane-ethanol solution at 293 and 77 K. Figures 2; references 4: 1 Russian, 3 Western (1 in Russian translation).
[113-2415]

ELECTRIC HEAT RADIATORS WITH PARTIAL UTILIZATION OF HEAT--PROMISING TREND IN ECONOMY OF ENERGY RESOURCES

YEFIMOV, V. F., candidate of technical sciences, KURKIN, A. N., engineer, PRON'KO, M. G., candidate of technical sciences, ROZHDESTVENSKAYA, L. G., engineer, and SOROKOUMOVA, N. V., engineer, All-Union Scientific Research Institute of Electrothermal Equipment

[Abstract] A latest energy saving trend in farm-industrial heating and ventilation practice is utilization of heat exhausted air. This is done efficiently by means of electric heat radiators with reversible regenerative heat exchangers. Such a unit consists of two parallel straight heat exchanger segments joined on the side through a 90° elbow each to a box at the center with a reversible flap inside and with two holes in opposite walls: one for blowing out air coming in through the heat exchangers and one for blowing in air exhausted from the heat exchangers, after it has passed across the electric radiator in front of the box. The main advantages of this device are its structural simplicity and easy manufacture with low-cost materials. Its main disadvantages are insufficient dehumidifying action and inefficient mixing of two air streams during flap reversal. By means of a control servomechanism, these disadvantages have been minimized in the SFOTs-40/0.5T-I1 heat radiator unit with an air conditioning capacity of 3300 m^3/h at inlet air temperature of 15-20°C. Its thermal power rating is 40 kW (electric radiator power 16 kW) and its overall dimensions are 3.2 m (length) x 2.7 m (width) x 1.2 m (height). At lower ambient temperatures the air flow rate must be reduced without reducing the electric radiator power. The heat exchanger segments are made of 20 mm wide and 1 mm thick corrugated smooth aluminum strips, with an effective surface-to-volume ratio of 650 m^2/m^3. The aerodynamic drag does not exceed 15o Pa at the nominal air flow rate. The heat utilization factor depends on the length of time between flap reversal: it decreases from 0.8 (theoretically) or 0.6 (experimentally) when the interval is shorter than 1 min to below 0.4 as the interval exceeds 4 min. The temperature distribution over the heat exchanger surface remains almost constant during nominal operation, with the temperature rise from cold ambient air to warm room air increasing as the heat utilization factor does. Figures 5; references: 4 Russian.
[120-2415]

EIS-0.25-I1 'IRIS' INFRARED ELECTRIC HEATER

LOPUKHOV, G. I., engineer, POVAROV, V. N., engineer, SLOBODSKOY, A. P., candidate of technical sciences, and KHODOV, V. N., engineer, All-Union Scientific Research Institute of Electrothermal Equipment

[Abstract] An infrared electric heater has been developed and built for live-stock farms. This EIS-0.25-I1 ("Iris") heater is designed for operation with SSP-01-250, "Astra", IKUF-1 and other Soviet-made lamps. Its nominal power is 250 W and it produces a mean temperature rise of 8-10°C above ambient over a 0.7 m^2 sty area, with a radiant flux density of 157.2 W/m^2. It is made of AD1M aluminum sheet, 178 mm in diameter and 192 mm high. The heater element is an Archimedes spiral of OKh23Yu5 chromium wire either encased in a ceramic disk 90 mm in diameter or strung through lamellar cordierite beads between flanges and bottom of a cylindrical cup made of 0.5 mm thick 10Kh14G14N4T heat-resistant sheet steel. The reflector is shaped so as to beam most of the radiant flux into the sty. The performance characteristics of the EIS-0.25-I1 heater surpass those of IKZK-220-250 heaters produced now at both Moscow and Kalash. 'kov Electric Lamp Manufacturing Plants. High efficiency of radiative heating, up to 72.3%, is ensured by adequate thermal insulation between heater element and housing (disk or cup) as well as by the air pocket between heater and reflector. One installed unit should reduce the cost of raising piglets by 7-9 rubles annually. Tables 1; references: 2 Russian.
[120-2415]

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